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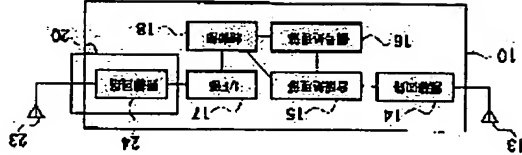
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## (54) RADIO EQUIPMENT

(57)Abstract:  
PROBLEM TO BE SOLVED: To realize a radio equipment which can reduce the price of the radio equipment body and can aim to improve communication function easily.

SOLUTION: Radio equipment of this invention is constituted by a radio equipment body (for example, a portable PC) which provides at least an antenna and at least a radio circuit and peripheral equipment (for example, a PC card) which has a radio circuit of a PC card, etc., which



can be detached and attached to the radio equipment body. The radio equipment body has a connecting means which can recognize the radio circuit of the peripheral equipment when the peripheral equipment is attached and can transmit signals. Furthermore, the radio equipment body has a synthesizing means which synthesizes the received signal through the radio circuit of the peripheral equipment recognized by the synthesizing means and the received signal through the radio circuit of the radio equipment body and has a decoding means which decodes the received signals synthesized by the synthesizing means. The peripheral equipment has a communication circuit which has desired communication function and makes it to be recognized as a diversity branch by attaching it to the radio equipment body.

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## CLAIMS

[Claim(s)]

[Claim 1] The body of a walkie-talkie possessing at least one antenna and at least one wireless circuit, It has at least one antenna and at least one wireless circuit, and said body of a walkie-talkie is equipped with a removable peripheral device. Said body of a walkie-talkie When the body of a walkie-talkie is equipped with said peripheral device, the wireless circuit of said peripheral device is recognized. The connecting means which enables transfer of a signal, and the input signal which went via the wireless circuit of the peripheral device recognized by said connecting means, Radio equipment characterized by providing further a synthetic means to compound the input signal which went via the wireless circuit of said body of a walkie-talkie, and a decode processing means to decode the input signal compounded with said synthetic means.

[Claim 2] The body of a walkie-talkie possessing two or more antennas and at least one wireless circuit, At least one wireless circuit is provided and said body of a walkie-talkie is equipped with a removable peripheral device. Said body of a walkie-talkie When the body of a walkie-talkie is equipped with said peripheral device, the wireless circuit of said peripheral device is recognized. The connecting means which enables transfer of a signal, and the input signal which went via the wireless circuit of the peripheral device recognized by said connecting means, Radio equipment characterized by providing further a synthetic means to compound the input signal which went via the wireless circuit of said body of a walkie-talkie, and a decode processing means to decode the input signal compounded with said synthetic means.

[Claim 3] It is the radio equipment according to claim 2 characterized by for some two or more antennas of said body of a walkie-talkie corresponding to each wireless circuit of the body of a walkie-talkie concerned, and the remainder of the antenna of said body of a walkie-talkie corresponding to each wireless circuit of said peripheral device.

[Claim 4] The 1st wireless circuit of N individual which performs RF signal processing to the signal received with the antenna of N individual (N>=2), and the antenna of said N individual, The body of a walkie-talkie which has the m 2nd wireless circuits (m>=1) which perform low frequency transform processing further to said input signal by which RF signal processing was carried out, It has the 2nd wireless circuit of an individual and said body of a walkie-talkie is equipped with a removable peripheral device. (N-m) Said body of a walkie-talkie The connecting means which recognizes the 2nd wireless circuit of said peripheral device, and enables transfer of a signal when said body of a walkie-talkie is equipped with said peripheral device, The input signal of the individual (N-m) which went via the 2nd wireless circuit of said peripheral device transmitted via said connecting means, Radio equipment characterized by providing further a synthetic means to compound m input signals which went via the 2nd wireless circuit of said body of a walkie-talkie, and a decode processing means to decode the input signal compounded with said synthetic means.

[Claim 5] The body of a walkie-talkie possessing at least one antenna and one wireless circuit, It has at least one antenna and at least one wireless circuit, and said body of a walkie-talkie is equipped with a removable peripheral device. Said body of a walkie-talkie When the body of a walkie-talkie is equipped with said peripheral device, the wireless circuit of said peripheral device is recognized and it has further the connecting means which enables transfer of a signal. Said peripheral device Radio equipment characterized by having further a synthetic means to compound the input signal which went via the wireless circuit of the body of a walkie-talkie recognized by said connecting means, and the input signal which went via the wireless circuit of said peripheral device.

[Claim 6] The body of a walkie-talkie possessing two or more antennas and one wireless circuit and at least one wireless circuit are provided, and said body of a walkie-talkie is equipped with a removable peripheral device. Said body of a walkie-talkie When the body of a walkie-talkie is equipped with said peripheral device, the wireless circuit of said peripheral device is recognized and it has further the connecting means which enables transfer of a signal. Said peripheral device Radio equipment characterized by having further a synthetic means to compound the input signal which went via the wireless circuit of the body of a walkie-talkie recognized by said said connecting means, and the input signal which went via the wireless circuit of said peripheral device.

[Claim 7] The 1st wireless circuit of N individual which performs RF signal processing to the signal received with the antenna of N individual (N>=2), and the antenna of said N individual, The body of a walkie-talkie which has the one 2nd wireless circuit which performs low frequency transform processing

further to said input signal by which RF signal processing was carried out, It has the 2nd wireless circuit of an individual and said body of a walkie-talkie is equipped with a removable peripheral device. (N-1) Said body of a walkie-talkie When said body of a walkie-talkie is equipped with said peripheral device, the 2nd wireless circuit of said peripheral device is recognized, and it has further the connecting means which enables transfer of a signal. Said peripheral device Radio equipment characterized by having further a synthetic means to compound one input signal which went via the 2nd wireless circuit of said body of a walkie-talkie transmitted via said connecting means, and the input signal of the individual (N-1) which went via the 2nd wireless circuit of said peripheral device.

[Claim 8] The synthetic means of said body of a walkie-talkie is radio equipment according to claim 1 to 4 characterized by rewriting the content of control with the actuation software given to said body of a walkie-talkie.

[Claim 9] The content of control of the synthetic means of said peripheral device is radio equipment according to claim 5 to 7 characterized by the ability to rewrite with the actuation software given to said body of a walkie-talkie when the peripheral device concerned is added to the body of a walkie-talkie.

[Claim 10] Said body of a walkie-talkie is radio equipment according to claim 1 to 9 characterized by displaying the beam pattern of the directional beam which has a display further and is formed of said antenna and a wireless circuit.

[Claim 11] Said body of a walkie-talkie is radio equipment according to claim 1 to 9 characterized by having a display further and displaying an antenna current in use and/. or a wireless circuit among said antenna and a wireless circuit.

[Claim 12] The message which said body of a walkie-talkie has a message-sending function further, and was created and modulated within said body of a walkie-talkie is radio equipment according to claim 1 to 11 characterized by being transmitted through the antenna of said radio equipment.

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[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]  
[0001]

[Field of the Invention] This invention relates to the radio equipment which consists of a body of a walkie-talkie, and a peripheral device removable on the body of a walkie-talkie with a wireless circuit. The body of a walkie-talkie means all the equipments that have a wireless function and a signal-processing function, for example, communication terminals, such as Personal Digital Assistants, such as a luggage computer with a wireless function and PDA, a cellular phone, and a land mobile radiotelephone, are also included.

[0002]

[Description of the Prior Art] By development of an information society in recent years, the number of users of a personal computer and a Personal Digital Assistant is increasing every year, and the usage is also diversified. The individual users who exchange multimedia information, such as a voice-told message and an image, also increase in number, and it has also become a natural thing to transmit and receive various and mass information using the Internet etc. as the improvement in the engine performance of these information machines and equipment accelerates. However, if mobility and portability are taken into consideration, there is a limitation in using the telephone line of a cable, and it is necessary to connect a pocket communication terminal to a notebook computer, or to insert the modem card only for wireless data transmission etc. in it.

[0003] On the contrary, the users who use the Internet, E-mail, etc. by the pocket communication terminal itself, such as a cellular phone and PHS, also increase in number, and the frequency where direct data utility is used with an information terminal still like an I mode is also increasing. However, neither lowering of the input rate to which it comes from that the actuation on a personal digital assistant has small case size, the little of an actuation key,

etc., nor complicatedness is avoided.

[0004] It can expect easily that the information communication equipment which intermingled for them or unified these appears from such a situation from now on. For example, it is expected that the model which carried an antenna and walkie-talkies, such as wireless LAN and Bluetooth, in the notebook computer appears on the market in a commercial scene, and there are some which are commercialized actually.

[0005] Drawing 6 is the information management system which unified the wireless function considered now. If there is a portable mold personal computer possessing such a wireless function, it can communicate "always anywhere", without asking indoor outside in [ which can be communicated ] area. However, in the case of the outdoors, it is actually influenced strongly of the propagation loss by the terrain feature, shadowing when entering into the ability smelling of a building, etc. Moreover, even if it does not move the terminal itself, the condition of an echo and dispersion may change for time fluctuation of a surrounding environment, and phasing may occur. Wireless circuit quality will deteriorate remarkably according to these phenomena as a result, and even if it can treat mass information with a personal computer, it becomes impossible to transmit and receive.

[0006] Moreover, the inconvenience of an information transmission rate falling, when radiocommunicating indoors and a wireless circuit situation worsens by how to place a personal computer since electric shielding by an echo, fixtures, and man of head lining, a wall, etc. arises frequently, or the installation, or a communication link stopping arises.

[0007] In order to solve this, by including two or more antennas and wireless circuits in a personal computer with a wireless function or a Personal Digital Assistant as shown in drawing 6 etc., diversity actuation is performed and a remarkable property improvement is expected. The effectiveness becomes larger as the number of walkie-talkie modules increases within the limit of the magnitude of the case of a terminal.

[0008]

[Problem(s) to be Solved by the Invention] However, it is not avoided that the price of a personal computer or a Personal Digital Assistant becomes high for the communication facility which adds the personal computer or Personal Digital Assistant possessing such two or more wireless circuits to basic functions, such as data processing, and is carried in a surplus. This is dramatically disadvantageous for the personal computer user who does not need a highly efficient radiocommunication function especially.

[0009] This invention aims at offering the radio equipment which can attain the communication link quality or transmission speed which is made in order to solve such a problem, and suppresses buildup of a price, and a user needs according to the object for every user.

## [0010]

[Means for Solving the Problem] In order to attain the above-mentioned object, in this invention, the minimum communication facility is included in an information management system side, such as a personal computer and a communication terminal, and it considers as the body of a walkie-talkie. It considers as the configuration which can, by the way, add the required communication facility which is the need by on the other hand including easily the radiocommunication function which a user needs according to an individual in a removable peripheral device, for example, a wireless PC card, at the body of a walkie-talkie.

[0011] In the 1st gestalt of this invention, radio equipment has at least one antenna, the body of a walkie-talkie possessing at least one wireless circuit, at least one antenna, and at least one wireless circuit, and, specifically, is constituted from a removable hole peripheral device by the body of a walkie-talkie. When a peripheral device is added, the body of a walkie-talkie has further the connecting means which recognizes the wireless circuit of a peripheral device and enables transfer of a signal, and compounds the input signal which went via the wireless circuit of the peripheral device recognized by the connecting means, and the input signal which went via the wireless circuit of the body of a walkie-talkie with a synthetic means. The compounded input signal is decoded with the decode processing means of the body of a walkie-talkie.

[0012] By such configuration, cost can be reduced compared with the body of a walkie-talkie which incorporated all of many antennas and a wireless circuit beforehand. Moreover, when using it in the inferior radio-wave-propagation environment where desired receiving quality or a desired information transmission rate cannot be attained, by equipping with the peripheral device which has a wireless function, the number of branches can be increased and diversity gain can be raised only in one wireless circuit of the wireless inside of a plane. Thereby, high communication link quality and high-speed transmission are realized. Moreover, since the peripheral device to add is easily removable, a user can use the peripheral device according to an application and the spec. to demand properly. Furthermore, a device manufacturer can prepare a peripheral device with various functions.

[0013] In the 2nd gestalt of this invention, the body side of a walkie-talkie is equipped with all antennas, optimization of an antenna location is beforehand attained by the body side, and it considers as the configuration which makes only a wireless circuit provide at a peripheral device.

[0014] That is, radio equipment possesses the body of a walkie-talkie possessing two or more antennas and at least one wireless circuit, and at least one wireless circuit, and is constituted from a removable peripheral device by the body of a walkie-talkie. When a peripheral device is added to

the body of a walkie-talkie, the body of a walkie-talkie recognizes the wireless circuit of a peripheral device, and has the connecting means which enables transfer of a signal. The body of a walkie-talkie has a synthetic means to compound the input signal which went via the wireless circuit of the peripheral device recognized by the connecting means further, and the input signal which went via the wireless circuit of the body of a walkie-talkie, and a decode processing means to decode the input signal compounded with the synthetic means.

[0015] It becomes possible to omit and low-cost[ a miniaturization and ]-ize an antenna from a peripheral device, and to offer the peripheral device of various functions and a class cheaply by this configuration, at the same time it attains optimization of an antenna location. Directional beam transmission is attained using two or more antennas arranged in the optimal location, and improvement in directional gain can protect that a communication link stops under an inferior radio-wave-propagation environment.

[0016] With the 3rd gestalt, carry out optimal arrangement of all the antennas at the body side of a walkie-talkie, and a filter, a low noise amplifier (LNA), etc. of the first rank in a wireless circuit are made to become independent of a wireless circuit, and it arranges near the antenna. The peripheral device which has a required wireless circuit on the other hand is prepared removable, and further improvement in the quality of an input signal is aimed at.

[0017] That is, radio equipment consists of a body of a walkie-talkie, and a peripheral device removable to this, and the body of a walkie-talkie has the 1st wireless circuit of N individual which performs RF signal processing to the signal received with the antenna of N individual ( $N \geq 2$ ), and the antenna of N individual, and the m 2nd wireless circuits ( $m \geq 1$ ) which perform low frequency transform processing further to the input signal by which RF signal processing was carried out. On the other hand, a peripheral device has the 2nd wireless circuit of an individual (N-m), and the each corresponds with one of the antennas by the side of the body of a walkie-talkie. When the body of a walkie-talkie is equipped with a peripheral device, the body of a walkie-talkie recognizes the 2nd wireless circuit of a peripheral device, and has the connecting means which enables transfer of a signal. The body of a walkie-talkie has a synthetic means to compound the input signal of the individual (N-m) which went via the 2nd wireless circuit of the peripheral device transmitted via the connecting means further, and m input signals which went via the 2nd wireless circuit of the body of a walkie-talkie, and a decode processing means to decode the input signal compounded with the synthetic means.

[0018] This configuration can prevent degradation of the SN ratio of the input signal resulting from an antenna and the amplifier (namely, the 1st

wireless circuit) of the first rank separating spatially, and being arranged within the body of a walkie-talkie. Moreover, the structure of the interface section of the body of a walkie-talkie and a peripheral device can be simplified by performing analog signal processing in the RF wireless circuit located directly under each antenna in the signal received with two or more antennas of the body of a walkie-talkie, and changing into the low frequency signal. Furthermore, the power consumption in the wireless circuit in a peripheral device can be reduced.

[0019] Although the signal composition processing section was prepared in the body side of a walkie-talkie in the 3rd gestalt from the above 1st, also in which gestalt, it can consider as the configuration which prepares the synthetic processing section in a peripheral device. In this case, where the body of a walkie-talkie is equipped with a peripheral device, the signal received with two or more antennas of the body of a walkie-talkie can be altogether transmitted to a peripheral device through the interface section (one of signals [them] is signal-processing ending with a body side wireless circuit), and even synthetic processing can be performed in a peripheral device. By this configuration, there is an advantage which can change the algorithm in the synthetic processing section easily.

[0020] Moreover, in the radio equipment of this invention, a synthetic means can rewrite the content of control with the actuation software given from the wireless section outside the plane. The software given through record media downloaded through the Internet as being given from the outside, such as software, CD-ROM, and a floppy (trademark) diskette, is included. The content of signal processing in the radio equipment which includes the wireless circuit of the added peripheral device by this configuration can be rewritten easily, and there is an advantage to which functional modification also becomes easy.

[0021] Preferably, the body of a walkie-talkie has a display further, and displays the beam pattern of the directional beam formed of the antenna and wireless circuit of radio equipment. Or it is good also as a configuration which displays an antenna current in use, one side of a wireless circuit, or both sides among the antenna of radio equipment, and a wireless circuit. A user can know visually the communication direction which has secured the good propagation path by display. There is an advantage which can move a luggable computer to the optimal location so that the user itself can perform a good communication link depending on the case.

[0022] In addition, in this invention, all the equipments that have the luggable computer possessing at least one antenna and a wireless circuit, a Personal Digital Assistant, a mobile communication telephone, and other radiocommunication functions are included with "the body of a walkie-talkie." When using a luggable computer especially, the capacity to

process various information, the outstanding user interface, etc. can be used. Moreover, the radio-signal processing and control using CPU in a computer also become possible. Furthermore, as a body of a walkie-talkie, duplication of a peripheral device is easy and there is an advantage which is excellent in expandability. Moreover, the cost of a body can be reduced compared with the luggable computer which carried two or more receiving circuits beforehand.

[0023] Moreover, the body of a walkie-talkie has a message-sending function, and can transmit the modulated message through the antenna of radio equipment. In the radio equipment of this invention, directional beam transmission is attained with two or more antennas by combining a peripheral device with a body removable. Therefore, directional gain can improve and it can prevent a communication link stopping under an inferior radio-wave-propagation environment.

[0024]

[Embodiment of the Invention] Hereafter, the operation gestalt of this invention is explained with reference to a drawing.

[0025] (The 1st operation gestalt) The example of a configuration of the radio equipment applied to the 1st operation gestalt of this invention at drawing 1 is shown. Radio equipment contains the luggable computer 10 as a body of a walkie-talkie, and wireless PC card 20 with which this is equipped removable. A luggable computer 10 has the wireless circuit 14 (only one is illustrated in drawing 1) of the number corresponding to one or more antennas 13 (only one is illustrated in drawing 1), and an antenna 13, the synthetic processing section 15, the signal-processing section 16, the interface (I/F) section 17, and a control section 18. On the other hand, wireless PC card 20 has one or more antennas 23 (only one is illustrated in drawing 1), and the wireless circuit 24 (only one is illustrated) of the number corresponding to this. Also in the following explanation, the antenna and wireless circuit which are built in each of a luggable computer 10 and wireless PC card 20 may be a configuration which it has for convenience, respectively in order [of explanation] to raise the diversity effectiveness although it is carrying out at a time to one line.

[0026] The wireless circuits 14 and 24 include a digital circuit etc. in the analog circuit of RF bands, such as a switch, a filter, amplifier, a mixer, and a synthesizer, and IF band, and the A/D converter and pan which carry out a down convert and which are changed into a digital signal in a suitable frequency band depending on a communication mode. Amplifier contains the low noise amplifier (LNA) which reduces a noise component.

[0027] Among these, in order that the wireless circuit 14 built in the body 10 of a luggable computer may enable a communication link with a computer simple substance, the circuit of transmitting systems, such as a D/A

converter and power amplifier (PA), is also included. On the other hand, although the direction of the wireless circuit 24 built in wireless PC card 20 may have a transmitting system, the following explanation describes as that in which only the receiving system is contained.

[0028] If wireless PC card 20 is inserted in the PC Card slot of a luggage computer 10, a control section 18 will make the I/F section 17 recognize wireless PC card 20, and it will change it into the condition which can exchange a signal with the wireless circuit 24 in the I/F section 17. The approach of accessing a control section 18 by the device driver installed in the computer 10 other than the approach which control-section 18 the very thing is made to recognize as an approach of making the wireless circuit 24 built in wireless PC card 20 recognizing etc. is possible. If a control section 18 recognizes wireless PC card 20 and connection becomes possible, it will be in the condition that the wireless circuit 24 by the side of wireless PC card 20 can also communicate.

[0029] The synthetic processing section 15 compounds the signal received with the antenna 13 by the side of a body, and the signal received with the antenna 24 of PC card 20. The signal-processing section 16 decodes the compounded input signal.

[0030] Next, it explains that a signal flows. First, predetermined signal processing is performed in the wireless circuits 14 and 24 where the signal received with the antennas 13 and 23 of the body of a walkie-talkie and a PC card corresponds, respectively. The 1st input signal received in the wireless circuit 14 of a luggage computer 10 is transmitted to the synthetic processing section 5 after signal processing. Moreover, the 2nd input signal processed in the wireless circuit 24 of wireless PC card 2 is transmitted to the synthetic processing section 5 through the I/F section 7. In the synthetic processing section 15, to the 1st input signal and 2nd input signal, change diversity or synthetic diversity is performed and, as for the composite signal, a data recovery is performed in the signal-processing section 16.

[0031] By this, space diversity reception is attained using two or more antennas, and by shadowing, phasing, etc., even when a

radio-wave-propagation environment is bad, lowering of an information transmission rate and communicative hits can be prevented. In this invention, as the number of the systems of the antenna with which radio equipment was equipped, and a wireless circuit increases, the effectiveness also becomes larger.

[0032] About the diversity approach, it is determined by driver software and an instruction is performed through a control section 18. That is, according to the surrounding situation and the surrounding radio-wave-propagation environment where the computer is placed, the user is the specification which can choose the expansion by the PC card, or the diversity approach

by each one.

[0033] Moreover, in the communication device of this invention, in consideration of arrangement of two or more antennas, beam directivity can be turned positively or directional gain of the arrival direction of an interference wave can also be lowered. Especially when using the PC card for beamforming with the gestalt of indoor wireless LAN, big upgrading can be aimed at by extracting reservation and directivity of a prospect. Various algorithms exist about the beamforming approach. For example, the approach of forming the multi-beam of a fixed pattern beforehand and forming a beam pattern from which an interference wave be remove by asking for an antenna wait which minimize an error using the property which the approach of changing a beam using information, such as a received signal level and an SN ratio, the known sequence include in an input signal, and an input signal have, or the spatial arrival direction of each incoming wave presume, and there be a method of turning the main lobe and the null of a beam pattern according to it etc.

[0034] Such beamforming reception can realize the content of control by rewriting modification or a signal-processing program with driver software. However, to use an algorithm which presumes the arrival direction of an incoming wave etc. to a precision, it is necessary to perform a calibration among two or more wireless circuits built in the luggage computer 1 and wireless PC card 20. If it puts in another way, in order to make the wireless circuit of a PC card coalesce and to operate both wireless circuits as the body of a personal computer correctly, functional adjustment is required and the additional information for it is needed. What is necessary is just to add the processing instruction for making the calibration section drive in such a case, for example, driver software.

[0035] the PC card which has a diversity function depending on the case -- receiving -- the function -- difference -- the calibration between beamforming and/or a wireless circuit is also realizable by coping with it by the hardware or software which incorporated only information. a function -- difference -- information may be beforehand stored in a hard disk and may be loaded as a program. As the load approach, it is also directly downloadable on the body of a walkie-talkie from the Internet etc.

[0036] By reinforcing communication facility with a PC card, improvement in directional gain can protect that a communication link stops under an inferior radio-wave-propagation environment. Moreover, the effect of the multi-pass frequently produced in indoor propagation can be reduced by forming a narrow directive beam.

[0037] In the radio equipment of the 1st operation gestalt, the body of a luggage computer is equipped only with minimum communication facility, and does not become expensive. The wireless PC card of an option is easy to



detach and attach, and extended service can be easily offered by functional duplication according to the object to the user who asks for high communication facility nature. Although the user who needs high performance will purchase a PC card according to the object, he is advantageous in respect of costs and flexibility rather than it purchases the multi-communication facility computer fixed beforehand. Moreover, for the user who does not need the high communication link engine performance, there is an advantage that the body of a computer to which fundamental communication facility was attached can be purchased cheaply.

[0038] Moreover, it does not depend for the radio equipment of this invention on the gestalt and connection method of a connection for detaching and attaching a wireless card. That is, with the above-mentioned operation gestalt, although the wireless PC card of PCMCIA is assumed, through the cable etc., the I/F section 17 and wireless PC card 20 separate, and may be connected. In this case, since the antenna 13 of a luggable computer 10 and the antenna 23 of PC card 20 separate considerably, and are arranged and spatial correlation of an input signal becomes small theoretically, it is effective in the diversity effectiveness increasing.

[0039] Moreover, if two or more wireless circuits and antennas possess in the luggable computer or the wireless PC card when a portable mold computer-applications person transmits large capacity information and quality information (i.e., when performing a high speed and high quality transmission in an uphill circuit), transmitting diversity or beamforming transmission can be performed. Although the precise calibration between the antenna and wireless circuit of each branch is needed when performing beamforming transmission as mentioned above, the functional information for it is easily realizable by loading additional software.

[0040] Improvement in high transmission of the reliability using space diversity or directional gain is realizable with such a configuration, and under an inferior radio-wave-propagation environment, a communication link can stop or it can prevent an information transmission rate falling.

[0041] (2nd operation gestalt) The example of a configuration of the radio equipment applied to the 2nd operation gestalt of this invention at drawing 2 is shown.

[0042] With the 2nd operation gestalt, optimization of an antenna location is beforehand attained by arranging two or more antennas of all to the body side of a walkie-talkie. Namely, as for a luggable computer 30, the radio equipment of the 2nd operation gestalt has two or more antennas 331-33N, one or more wireless circuits 341, the synthetic processing section 35, the signal-processing section 36, the interface (I/F) section 37, and a control section 38 including a luggable computer 30 and wireless PC card 40. On the other hand, wireless PC card 40 has the wireless circuits 342-34N. Here, N

expresses the total of the antenna contained in the whole radio equipment of this invention. This is in agreement also with the total of a wireless circuit. [0043] The wireless circuits 341-34N include a digital circuit etc. in the analog circuit of RF bands, such as a switch, a filter, amplifier, a mixer, and a synthesizer, and IF band, and the A/D converter and pan which carry out a down convert and which are changed into a digital signal in a suitable frequency band like the 1st operation gestalt depending on a communication mode.

[0044] With the 2nd operation gestalt, only two or more wireless circuits 342-34N are included in wireless PC card 40, and, on the other hand, two or more antennas 331-33N are beforehand carried in the luggable computer 30.

[0045] The flow of the signal in the radio equipment of the 2nd operation gestalt is explained. First, through the I/F section 37, the signal received with Antennas 332-33N flows into wireless PC card 40 with which it was equipped, and is processed in the corresponding wireless circuits 342-34N.

Then, it is again sent to the synthetic processing section 35 through the I/F section 7. Here, diversity composition is performed with the input signal inputted through the wireless circuit 341 by the side of a body from an antenna 331. At this time, a control section 38 is controlled so that the wireless circuits 342-34N of wireless PC card 40 and 332-33 Ns of antennas of a luggable computer 30 are correctly connected in the I/F section 37.

[0046] By such configuration, with the radio equipment concerning the 2nd operation gestalt, two or more antennas can be beforehand arranged in the condition ideal on the case of a luggable computer 30, and optimization of the distance between antennas or the directive sense becomes easy. When carrying out diversity reception especially, the magnitude of a computer case can be utilized and the distance between antennas can be detached as much as possible rather than it carries two or more antennas on a PC card small in size. By this, space correlation of an input signal can be made small and diversity gain can be earned.

[0047] (3rd operation gestalt) Drawing 3 shows the example of a configuration of the radio equipment concerning the 3rd operation gestalt of this invention. With the 3rd operation gestalt, while arranging all antennas to the body side of a computer, the 1st wireless circuit containing the filter and LNA (low noise amplifier) of the first rank is arranged directly under each antenna.

[0048] As for a luggable computer 30, radio equipment has Antennas 331-33N, the 1st wireless circuits 391-39N, the 2nd wireless circuit 341, the synthetic processing section 35, the signal-processing section 36, the interface (I/F) section 37, and a control section 38 including a luggable computer 30 and wireless PC card 40. On the other hand, wireless PC card 40 has the 2nd wireless circuits 342-34N. the 2nd wireless circuits 341-34N



of the 3rd operation gestalt -- the 1st and 2nd operation gestalt -- differing -- the first rank -- a filter and LNA are not included. LNA etc. is arranged near the antenna 33 by the side of a computer 30 as a circuit 39 according to individual (the 1st wireless circuit).

[0049] That is, with the 3rd operation gestalt, wireless PC card 40 has two or more wireless circuits (the 2nd wireless circuit) 342-34N which do not contain LNA etc., and serves as the configuration that the 1st wireless circuits 391-39N which contain two or more Antennas 331-33N and LNA(s) in a luggable computer 30 beforehand are carried by the optimal arrangement.

[0050] It explains that a signal flows. First, after RF processing is carried out in the 1st wireless circuits 392-39N, and the signal received with Antennas 332-33N flows into wireless PC card 40 with which it was equipped after passing the I/F section 37 and is processed in the corresponding 2nd wireless circuits 342-34N, it is again sent to the synthetic processing section 35 through the I/F section 37. Here, it is received by the antenna 331 and diversity composition is performed with the input signal inputted through the 2nd wireless circuit 341 after processing by the 1st wireless circuit 391. At this time, a control section 38 is controlled so that the 2nd wireless circuits 342-34N of wireless PC card 40 and the 392-39 Ns of the 1st wireless circuits of a luggable computer 30 are correctly connected in the I/F section 37.

[0051] general -- a low noise amplifier (LNA) -- a receiving circuit -- it is the amplifier of the first rank and the signal in front of a LNA input is a signal with worst S/N in a receiving system. For this reason, in order to avoid addition of a noise if possible, as for wiring from an antenna to LNA, shortening as much as possible is desirable. Therefore, by the configuration of the 3rd operation gestalt, although the components mark in a luggable computer increase, an antenna and LNA (the 1st wireless circuit) can be arranged to near, and degradation of the S/N ratio of an input signal can be prevented, and from the point of improvement in the quality of an input signal, it is an advantageous configuration. Moreover, the power consumption in the wireless circuit in a PC card can be reduced by arranging LNA39 which is an active component to the body side of a computer. Furthermore, it is effective to arrange LNA also in respect of the cure against heat on the body of a computer with which the cure against heat is fully performed.

[0052] Although it is the gestalt which includes the RF signal-processing component to LNA as the 1st wireless circuit with the 3rd operation gestalt, a subsequent filter, a subsequent frequency variable circuit, etc. may carry out N individual preparation beforehand into a luggable computer. In this case, although divided into the 2nd wireless circuit which carries out frequency conversion of the input signal processed in the 1st wireless circuit

of N individual linking directly to an antenna, and the 1st wireless circuit further, the remainder will be built in a wireless PC card that what is necessary is just to prepare only 2nd at least one wireless circuit in the luggable computer.

[0053] (4th operation gestalt) The example of a configuration of the radio equipment applied to the 4th operation gestalt of this invention at drawing 4 is shown. With the 4th operation gestalt, it considers as the structure of performing synthetic processing of diversity, beamforming, etc. in DSP and the gate array in which it is contained by the PC card.

[0054] In the example shown in drawing 4, a luggable computer 50 has Antennas 531-53N, the wireless circuit 541, the signal-processing section 56, the interface (I/F) section 57, and a control section 58. On the other hand, wireless PC card 60 has the wireless circuits 542-54N and the synthetic processing section 55. Here, N expresses the number of the wireless circuits corresponding to the antenna and it which are contained in the whole radio equipment of this invention.

[0055] the wireless circuits 541-54N -- the 1st and 2nd operation gestalt -- the same -- the analog circuit of RF bands, such as a switch, a filter, an amplifier (LNA is included), a mixer, and a synthesizer, and IF band, and the A/D converter which carries out a down convert and which is changed into a digital signal in a suitable frequency band -- depending on a communication mode, a digital circuit etc. is included further.

[0056] With the 4th operation gestalt, although the point that two or more antennas 531-53N are beforehand carried in the luggable computer 50, and the point that two or more wireless circuits 542-54N are carried in wireless PC card 60 are the same as the 2nd and 3rd operation gestalten, it differs in that the synthetic processing section 55 is contained in wireless PC card 60.

[0057] It explains that the signal in this radio equipment flows. First, after the signal received with Antennas 532-53N flows into wireless PC card 60 with which it was equipped after passing the I/F section 57 and is processed in each wireless circuits 542-54N, it is sent to the synthetic processing section 55. Moreover, after the signal received with the antenna 531 is processed in the wireless circuit 541 by the side of a body, it is sent to the synthetic processing section 55 by the side of a PC card through the I/F section 57. Beamforming is performed in the synthetic processing section 55, and it is again sent to the signal-processing section 56 through the I/F section 57. At this time, a control section 58 is controlled so that the wireless circuits 542-54N of wireless PC card 60 and 532-53 Ns of antennas of a luggable computer 50 are correctly connected in the I/F section 57.

[0058] A control section 58 is controlled again not to send the input signal from the wireless circuit 541 by the side of a body to the signal-processing

section 56 directly, but to be sent to the synthetic processing section 55 by the side of a PC card from the I/F section 57, when equipped with wireless PC card 60. On the other hand, when not equipped with wireless PC card 60, it controls to send to the direct signal-processing section 56.

[0059] Thus, without changing the body of a luggage computer by carrying the synthetic processing section on a wireless PC card, it can change into the diversity approach and beamforming algorithm suitable for a surrounding radio-wave-propagation situation easily, and the optimal communication link can be performed.

[0060] Thus, the configuration which prepares the synthetic processing section in a wireless PC card is applicable also to the radio equipment of the 1st operation gestalt - 3rd operation gestalt. In this case, each once regains two or more input signals delivery and after that at the signal-processing section by the side of the body of a computer in the synthetic processing section by the side of a wireless PC card, and decode processing is performed.

[0061] Also in any of the 1st operation gestalt - 4th operation gestalt, radio equipment of this invention can be considered as the configuration which displays the antenna branch used now, when change diversity control is performed, the image display according [ in / as shown in drawing 5 as the method of presentation / the screen top of a luggage computer ] to software -- or the LED display on a computer case etc. is raised. Moreover, when beamforming control is performed, a screen display of the directivity response pattern currently formed can also be carried out.

[0062] In the example of drawing 5, the antenna pattern seen from right above is displayed in the window on the screen of a computer. By such display, a computer user can know visually the communication direction which has secured the good propagation path, and he can move a luggage computer so that the user itself can perform a good communication link depending on the case. Moreover, there is an advantage which can be employed and managed independently of the body of a computer by supplying a display function by software. It is independent, respectively and, of course, it is also possible to display the beam pattern of an antenna or the antenna branch currently used.

[0063] Furthermore, with the above-mentioned operation gestalt, although explained taking the case of signal reception, also in any of the 1st operation gestalt - 4th operation gestalt, the message or sending signal created by the body of a computer can also be transmitted from two or more antennas of radio equipment. By using two or more antennas, directional beam transmission is attained and directional gain improves. Thereby, even if radio wave propagation is an inferior environment, it can prevent a communication link stopping.

[0064] In addition, in the operation gestalt of all above, although the body of a walkie-talkie was explained as a luggage computer which has a wireless function and the removable peripheral device has been explained to a body as a wireless PC card, it cannot be overemphasized by building a small wireless circuit device etc. into the equipment which has the other same function, for example, a cellular phone and a Personal Digital Assistant, enabling free attachment and detachment that the same effectiveness is attained.

[0065]

[Effect of the Invention] As explained above, according to this invention, the radio equipment which has two or more antennas is divided and constituted in the luggage computer possessing at least one antenna and a wireless circuit, and a PC card removable to it with a wireless circuit. On the body of a luggage computer, it can have only necessary minimum communication facility, low cost-ization can be attained, on the other hand, a wireless PC card can be added to the user who demands a high speed and a quality communication link according to the object, and improvement in the engine performance can be aimed at free according to the diversity effectiveness. [0066] Moreover, control of Make Changes, expansion, etc. becomes easy by offering the parameter about the diversity approach or signal processing etc. with driver software.

[0067] It can prevent a communication link stopping under an inferior radio-wave-propagation environment for improvement in directional gain, or the interference clearance effectiveness by introducing a beamforming algorithm in addition to this instead of diversity.

[0068] furthermore, difference [ in / at this time / both algorithms such as the calibration approach, ] -- there is effectiveness which makes a change of an algorithm easy by making information recognize using driver software.

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**TECHNICAL FIELD**

[Field of the Invention] This invention relates to the radio equipment which consists of a body of a walkie-talkie, and a peripheral device removable on the body of a walkie-talkie with a wireless circuit. The body of a walkie-talkie means all the equipments that have a wireless function and a signal-processing function, for example, communication terminals, such as Personal Digital Assistants, such as a luggage computer with a wireless function and PDA, a cellular phone, and a land mobile radiotelephone, are also included.

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**PRIOR ART**

[Description of the Prior Art] By development of an information society in recent years, the number of users of a personal computer and a Personal Digital Assistant is increasing every year, and the usage is also diversified. The individual users who exchange multimedia information, such as a voice-told message and an image, also increase in number, and it has also become a natural thing to transmit and receive various and mass information using the Internet etc. as the improvement in the engine performance of these information machines and equipment accelerates. However, if mobility and portability are taken into consideration, there is a limitation in using the telephone line of a cable, and it is necessary to connect a pocket communication terminal to a notebook computer, or to insert the modem card only for wireless data transmission etc. in it.

[0003] On the contrary, the users who use the Internet, E-mail, etc. by the pocket communication terminal itself, such as a cellular phone and PHS, also increase in number, and the frequency where direct data utility is used with an information terminal still like an I mode is also increasing. However, neither lowering of the input rate to which it comes from that the actuation on a personal digital assistant has small case size, the little of an actuation key, etc., nor complicatedness is avoided.

[0004] It can expect easily that the information communication equipment which intermingled for them or unified these appears from such a situation from now on. For example, it is expected that the model which carried an antenna and walkie-talkies, such as wireless LAN and Bluetooth, in the notebook computer appears on the market in a commercial scene, and there are some which are commercialized actually.

[0005] Drawing 6 is the information management system which unified the wireless function considered now. If there is a portable mold personal computer possessing such a wireless function, it can communicate "always anywhere", without asking indoor outside in [ which can be communicated ]

area. However, in the case of the outdoors, it is actually influenced strongly of the propagation loss by the terrain feature, shadowing when entering into the ability smelling of a building, etc. Moreover, even if it does not move the terminal itself, the condition of an echo and dispersion may change for time fluctuation of a surrounding environment, and phasing may occur. Wireless circuit quality will deteriorate remarkably according to these phenomena as a result, and even if it can treat mass information with a personal computer, it becomes impossible to transmit and receive.

[0006] Moreover, the inconvenience of an information transmission rate falling, when radiocommunicating indoors and a wireless circuit situation worsens by how to place a personal computer since electric shielding by an echo, fixtures, and man of head lining, a wall, etc. arises frequently, or the installation, or a communication link stopping arises.

[0007] In order to solve this, by including two or more antennas and wireless circuits in a personal computer with a wireless function or a Personal Digital Assistant as shown in drawing 6 etc., diversity actuation is performed and a remarkable property improvement is expected. The effectiveness becomes larger as the number of walkie-talkie modules increases within the limit of the magnitude of the case of a terminal.

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**EFFECT OF THE INVENTION**

[Effect of the Invention] As explained above, according to this invention, the radio equipment which has two or more antennas is divided and constituted in the luggage computer possessing at least one antenna and a wireless circuit, and a PC card removable to it with a wireless circuit. On the body of a luggage computer, it can have only necessary minimum communication facility, low cost-ization can be attained, on the other hand, a wireless PC card can be added to the user who demands a high speed and a quality communication link according to the object, and improvement in the engine performance can be aimed at free according to the diversity effectiveness. [0066] Moreover, control of Make Changes, expansion, etc. becomes easy by offering the parameter about the diversity approach or signal processing etc. with driver software.

[0067] It can prevent a communication link stopping under an inferior radio-wave-propagation environment for improvement in directional gain, or the interference clearance effectiveness by introducing a beamforming algorithm in addition to this instead of diversity. [0068] furthermore, difference [ in / at this time / both algorithms such as the calibration approach, ] — there is effectiveness which makes a change of an algorithm easy by making information recognize using driver software.

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**TECHNICAL PROBLEM**

[Problem(s) to be Solved by the Invention] However, it is not avoided that the price of a personal computer or a Personal Digital Assistant becomes high for the communication facility which adds the personal computer or Personal Digital Assistant possessing such two or more wireless circuits to basic functions, such as data processing, and is carried in a surplus. This is dramatically disadvantageous for the personal computer user who does not need a highly efficient radiocommunication function especially.

[0009] This invention aims at offering the radio equipment which can attain the communication link quality or transmission speed which is made in order to solve such a problem, and suppresses buildup of a price, and a user needs according to the object for every user.

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## MEANS

[Means for Solving the Problem] In order to attain the above-mentioned object, in this invention, the minimum communication facility is included in an information management system side, such as a personal computer and a communication terminal, and it considers as the body of a walkie-talkie. It considers as the configuration which can, by the way, add the required communication facility which is the need by on the other hand including easily the radiocommunication function which a user needs according to an individual in a removable peripheral device, for example, a wireless PC card, at the body of a walkie-talkie.

[0011] In the 1st gestalt of this invention, radio equipment has at least one antenna, the body of a walkie-talkie possessing at least one wireless circuit, at least one antenna, and at least one wireless circuit, and, specifically, is constituted from a removable hole peripheral device by the body of a walkie-talkie. When a peripheral device is added, the body of a walkie-talkie has further the connecting means which recognizes the wireless circuit of a peripheral device and enables transfer of a signal, and compounds the input signal which went via the wireless circuit of the peripheral device recognized by the connecting means, and the input signal which went via the wireless circuit of the body of a walkie-talkie with a synthetic means. The compounded input signal is decoded with the decode processing means of the body of a walkie-talkie.

[0012] By such configuration, cost can be reduced compared with the body of a walkie-talkie which incorporated all of many antennas and a wireless circuit beforehand. Moreover, when using it in the inferior radio-wave-propagation environment where desired receiving quality or a desired information transmission rate cannot be attained, by equipping with the peripheral device which has a wireless function, the number of branches can be increased and diversity gain can be raised only in one wireless circuit of the wireless inside of a plane. Thereby, high communication link quality and

high-speed transmission are realized. Moreover, since the peripheral device to add is easily removable, a user can use the peripheral device according to an application and the spec. to demand properly. Furthermore, a device manufacturer can prepare a peripheral device with various functions.

[0013] In the 2nd gestalt of this invention, the body side of a walkie-talkie is equipped with all antennas, optimization of an antenna location is beforehand attained by the body side, and it considers as the configuration which makes only a wireless circuit provide at a peripheral device.

[0014] That is, radio equipment possesses the body of a walkie-talkie possessing two or more antennas and at least one wireless circuit, and at least one wireless circuit, and is constituted from a removable peripheral device by the body of a walkie-talkie. When a peripheral device is added to the body of a walkie-talkie, the body of a walkie-talkie recognizes the wireless circuit of a peripheral device, and has the connecting means which enables transfer of a signal. The body of a walkie-talkie has a synthetic means to compound the input signal which went via the wireless circuit of the peripheral device recognized by the connecting means further, and the input signal which went via the wireless circuit of the body of a walkie-talkie, and a decode processing means to decode the input signal compounded with the synthetic means.

[0015] It becomes possible to omit and low-cost[ a miniaturization and ]-ize an antenna from a peripheral device, and to offer the peripheral device of various functions and a class cheaply by this configuration, at the same time it attains optimization of an antenna location. Directional beam transmission is attained using two or more antennas arranged in the optimal location, and improvement in directional gain can protect that a communication link stops under an inferior radio-wave-propagation environment.

[0016] With the 3rd gestalt, carry out optimal arrangement of all the antennas at the body side of a walkie-talkie, and a filter, a low noise amplifier (LNA), etc. of the first rank in a wireless circuit are made to become independent of a wireless circuit, and it arranges near the antenna. The peripheral device which has a required wireless circuit on the other hand is prepared removable, and further improvement in the quality of an input signal is aimed at.

[0017] That is, radio equipment consists of a body of a walkie-talkie, and a peripheral device removable to this, and the body of a walkie-talkie has the 1st wireless circuit of N individual which performs RF signal processing to the signal received with the antenna of N individual ( $N \geq 2$ ), and the antenna of N individual, and the m 2nd wireless circuits ( $m \geq 1$ ) which perform low frequency transform processing further to the input signal by which RF signal processing was carried out. On the other hand, a peripheral device has the 2nd wireless circuit of an individual (N-m), and the each corresponds with



one of the antennas by the side of the body of a walkie-talkie. When the body of a walkie-talkie is equipped with a peripheral device, the body of a walkie-talkie recognizes the 2nd wireless circuit of a peripheral device, and has the connecting means which enables transfer of a signal. The body of a walkie-talkie has a synthetic means to compound the input signal of the individual (N-m) which went via the 2nd wireless circuit of the peripheral device transmitted via the connecting means further, and m input signals which went via the 2nd wireless circuit of the body of a walkie-talkie, and a decode processing means to decode the input signal compounded with the synthetic means.

[0018] This configuration can prevent degradation of the SN ratio of the input signal resulting from an antenna and the amplifier (namely, the 1st wireless circuit) of the first rank separating spatially, and being arranged within the body of a walkie-talkie. Moreover, the structure of the interface section of the body of a walkie-talkie and a peripheral device can be simplified by performing analog signal processing in the RF wireless circuit located directly under each antenna in the signal received with two or more antennas of the body of a walkie-talkie, and changing into the low frequency signal. Furthermore, the power consumption in the wireless circuit in a peripheral device can be reduced.

[0019] Although the signal composition processing section was prepared in the body side of a walkie-talkie in the 3rd gestalt from the above 1st, also in which gestalt, it can consider as the configuration which prepares the synthetic processing section in a peripheral device. In this case, where the body of a walkie-talkie is equipped with a peripheral device, the signal received with two or more antennas of the body of a walkie-talkie can be altogether transmitted to a peripheral device through the interface section (one of signals [them] is signal-processing ending with a body side wireless circuit), and even synthetic processing can be performed in a peripheral device. By this configuration, there is an advantage which can change the algorithm in the synthetic processing section easily.

[0020] Moreover, in the radio equipment of this invention, a synthetic means can rewrite the content of control with the actuation software given from the wireless section outside the plane. The software given through record media downloaded through the Internet as being given from the outside, such as software, CD-ROM, and a floppy (trademark) diskette, is included. The content of signal processing in the radio equipment which includes the wireless circuit of the added peripheral device by this configuration can be rewritten easily, and there is an advantage to which functional modification also becomes easy.

[0021] Preferably, the body of a walkie-talkie has a display further, and displays the beam pattern of the directional beam formed of the antenna and

wireless circuit of radio equipment. Or it is good also as a configuration which displays an antenna current in use, one side of a wireless circuit, or both sides among the antenna of radio equipment, and a wireless circuit. A user can know visually the communication direction which has secured the good propagation path by display. There is an advantage which can move a luggable computer to the optimal location so that the user itself can perform a good communication link depending on the case.

[0022] In addition, in this invention, all the equipments that have the luggable computer possessing at least one antenna and a wireless circuit, a Personal Digital Assistant, a mobile communication telephone, and other radiocommunication functions are included with "the body of a walkie-talkie." When using a luggable computer especially, the capacity to process various information, the outstanding user interface, etc. can be used. Moreover, the radio-signal processing and control using CPU in a computer also become possible. Furthermore, as a body of a walkie-talkie, duplication of a peripheral device is easy and there is an advantage which is excellent in expandability. Moreover, the cost of a body can be reduced compared with the luggable computer which carried two or more receiving circuits beforehand.

[0023] Moreover, the body of a walkie-talkie has a message-sending function, and can transmit the modulated message through the antenna of radio equipment. In the radio equipment of this invention, directional beam transmission is attained with two or more antennas by combining a peripheral device with a body removable. Therefore, directional gain can improve and it can prevent a communication link stopping under an inferior radio-wave-propagation environment.

[0024]

[Embodiment of the Invention] Hereafter, the operation gestalt of this invention is explained with reference to a drawing.

[0025] (The 1st operation gestalt) The example of a configuration of the radio equipment applied to the 1st operation gestalt of this invention at drawing 1 is shown. Radio equipment contains the luggable computer 10 as a body of a walkie-talkie, and wireless PC card 20 with which this is equipped removable. A luggable computer 10 has the wireless circuit 14 (only one is illustrated in drawing 1) of the number corresponding to one or more antennas 13 (only one is illustrated in drawing 1), and an antenna 13, the synthetic processing section 15, the signal-processing section 16, the interface (I/F) section 17, and a control section 18. On the other hand, wireless PC card 20 has one or more antennas 23 (only one is illustrated in drawing 1), and the wireless circuit 24 (only one is illustrated) of the number corresponding to this. Also in the following explanation, the antenna and wireless circuit which are built in each of a luggable computer 10 and

wireless PC card 20 may be a configuration which it has for convenience, respectively in order [ of explanation ] to raise the diversity effectiveness although it is carrying out at a time to one line.

[0026] The wireless circuits 14 and 24 include a digital circuit etc. in the analog circuit of RF bands, such as a switch, a filter, amplifier, a mixer, and a synthesizer, and IF band, and the A/D converter and pan which carry out a down convert and which are changed into a digital signal in a suitable frequency band depending on a communication mode. Amplifier contains the low noise amplifier (LNA) which reduces a noise component.

[0027] Among these, in order that the wireless circuit 14 built in the body 10 of a luggage computer may enable a communication link with a computer simple substance, the circuit of transmitting systems, such as a D/A converter and power amplifier (PA), is also included. On the other hand, although the direction of the wireless circuit 24 built in wireless PC card 20 may have a transmitting system, the following explanation describes as that in which only the receiving system is contained.

[0028] If wireless PC card 20 is inserted in the PC Card slot of a luggage computer 10, a control section 18 will make the I/F section 17 recognize wireless PC card 20, and it will change it into the condition which can exchange a signal with the wireless circuit 24 in the I/F section 17. The approach of accessing a control section 18 by the device driver installed in the computer 10 other than the approach which control-section 18 the very thing is made to recognize as an approach of making the wireless circuit 24 built in wireless PC card 20 recognizing etc. is possible. If a control section 18 recognizes wireless PC card 20 and connection becomes possible, it will be in the condition that the wireless circuit 24 by the side of wireless PC card 20 can also communicate.

[0029] The synthetic processing section 15 compounds the signal received with the antenna 13 by the side of a body, and the signal received with the antenna 24 of PC card 20. The signal-processing section 16 decodes the compounded input signal.

[0030] Next, it explains that a signal flows. First, predetermined signal processing is performed in the wireless circuits 14 and 24 where the signal received with the antennas 13 and 23 of the body of a walkie-talkie and a PC card corresponds, respectively. The 1st input signal received in the wireless circuit 14 of a luggage computer 10 is transmitted to the synthetic processing section 5 after signal processing. Moreover, the 2nd input signal processed in the wireless circuit 24 of wireless PC card 2 is transmitted to the synthetic processing section 5 through the I/F section 7. In the synthetic processing section 15, to the 1st input signal and 2nd input signal, change diversity or synthetic diversity is performed and, as for the composite signal, a data recovery is performed in the signal-processing section 16.

[0031] By this, space diversity reception is attained using two or more antennas, and by shadowing, phasing, etc., even when a radio-wave-propagation environment is bad, lowering of an information transmission rate and communicative hits can be prevented. In this invention, as the number of the systems of the antenna with which radio equipment was equipped, and a wireless circuit increases, the effectiveness also becomes larger.

[0032] About the diversity approach, it is determined by driver software and an instruction is performed through a control section 18. That is, according to the surrounding situation and the surrounding radio-wave-propagation environment where the computer is placed, the user is the specification which can choose the expansion by the PC card, or the diversity approach by each one.

[0033] Moreover, in the communication device of this invention, in consideration of arrangement of two or more antennas, beam directivity can be turned positively or directional gain of the arrival direction of an interference wave can also be lowered. Especially when using the PC card for beamforming with the gestalt of indoor wireless LAN, big upgrading can be aimed at by extracting reservation and directivity of a prospect. Various algorithms exist about the beamforming approach. For example, the approach of forming the multi-beam of a fixed pattern beforehand and forming a beam pattern from which an interference wave be remove by asking for an antenna wait which minimize an error using the property which the approach of changing a beam using information, such as a received signal level and an SN ratio, the known sequence include in an input signal, and an input signal have, or the spatial arrival direction of each incoming wave presume, and there be a method of turning the main lobe and the null of a beam pattern according to it etc.

[0034] Such beamforming reception can realize the content of control by rewriting modification or a signal-processing program with driver software. However, to use an algorithm which presumes the arrival direction of an incoming wave etc. to a precision, it is necessary to perform a calibration among two or more wireless circuits built in the luggage computer 1 and wireless PC card 20. If it puts in another way, in order to make the wireless circuit of a PC card coalesce and to operate both wireless circuits as the body of a personal computer correctly, functional adjustment is required and the additional information for it is needed. What is necessary is just to add the processing instruction for making the calibration section drive in such a case, for example, driver software.

[0035] the PC card which has a diversity function depending on the case -- receiving -- the function -- difference -- the calibration between beamforming and/or a wireless circuit is also realizable by coping with it by

the hardware or software which incorporated only information. a function -- difference -- information may be beforehand stored in a hard disk and may be loaded as a program. As the load approach, it is also directly downloadable on the body of a walkie-talkie from the Internet etc.

[0036] By reinforcing communication facility with a PC card, improvement in directional gain can protect that a communication link stops under an inferior radio-wave-propagation environment. Moreover, the effect of the multi-pass frequently produced in indoor propagation can be reduced by forming a narrow directive beam.

[0037] In the radio equipment of the 1st operation gestalt, the body of a luggage computer is equipped only with minimum communication facility, and does not become expensive. The wireless PC card of an option is easy to detach and attach, and extended service can be easily offered by functional duplication according to the object to the user who asks for high communication facility nature. Although the user who needs high performance will purchase a PC card according to the object, he is advantageous in respect of costs and flexibility rather than it purchases the multi-communication facility computer fixed beforehand. Moreover, for the user who does not need the high communication link engine performance, there is an advantage that the body of a computer to which fundamental communication facility was attached can be purchased cheaply.

[0038] Moreover, it does not depend for the radio equipment of this invention on the gestalt and connection method of a connection for detaching and attaching a wireless card. That is, with the above-mentioned operation gestalt, although the wireless PC card of PCMCIA is assumed, through the cable etc., the I/F section 17 and wireless PC card 20 separate, and may be connected. In this case, since the antenna 13 of a luggage computer 10 and the antenna 23 of PC card 20 separate considerably, and are arranged and spatial correlation of an input signal becomes small theoretically, it is effective in the diversity effectiveness increasing.

[0039] Moreover, if two or more wireless circuits and antennas possess in the luggage computer or the wireless PC card when a portable mold computer-applications person transmits large capacity information and quality information (i.e., when performing a high speed and high quality transmission in an uphill circuit), transmitting diversity or beamforming transmission can be performed. Although the precise calibration between the antenna and wireless circuit of each branch is needed when performing beamforming transmission as mentioned above, the functional information for it is easily realizable by loading additional software.

[0040] Improvement in high transmission of the reliability using space diversity or directional gain is realizable with such a configuration, and under an inferior radio-wave-propagation environment, a communication link can

stop or it can prevent an information transmission rate falling.

[0041] (2nd operation gestalt) The example of a configuration of the radio equipment applied to the 2nd operation gestalt of this invention at drawing 2 is shown.

[0042] With the 2nd operation gestalt, optimization of an antenna location is beforehand attained by arranging two or more antennas of all to the body side of a walkie-talkie. Namely, as for a luggage computer 30, the radio equipment of the 2nd operation gestalt has two or more antennas 331-33N, one or more wireless circuits 341, the synthetic processing section 35, the signal-processing section 36, the interface (I/F) section 37, and a control section 38 including a luggage computer 30 and wireless PC card 40. On the other hand, wireless PC card 40 has the wireless circuits 342-34N. Here, N expresses the total of the antenna contained in the whole radio equipment of this invention. This is in agreement also with the total of a wireless circuit.

[0043] The wireless circuits 341-34N include a digital circuit etc. in the analog circuit of RF bands, such as a switch, a filter, amplifier, a mixer, and a synthesizer, and IF band, and the A/D converter and pan which carry out a down convert and which are changed into a digital signal in a suitable frequency band like the 1st operation gestalt depending on a communication mode.

[0044] With the 2nd operation gestalt, only two or more wireless circuits 342-34N are included in wireless PC card 40, and, on the other hand, two or more antennas 331-33N are beforehand carried in the luggage computer 30.

[0045] The flow of the signal in the radio equipment of the 2nd operation gestalt is explained. First, through the I/F section 37, the signal received with Antennas 332-33N flows into wireless PC card 40 with which it was equipped, and is processed in the corresponding wireless circuits 342-34N.

Then, it is again sent to the synthetic processing section 35 through the I/F section 7. Here, diversity composition is performed with the input signal inputted through the wireless circuit 341 by the side of a body from an antenna 331. At this time, a control section 38 is controlled so that the wireless circuits 342-34N of wireless PC card 40 and 332-33 Ns of antennas of a luggage computer 30 are correctly connected in the I/F section 37.

[0046] By such configuration, with the radio equipment concerning the 2nd operation gestalt, two or more antennas can be beforehand arranged in the condition ideal on the case of a luggage computer 30, and optimization of the distance between antennas or the directive sense becomes easy. When carrying out diversity reception especially, the magnitude of a computer case can be utilized and the distance between antennas can be detached as much as possible rather than it carries two or more antennas on a PC card small in size. By this, space correlation of an input signal can be made small and diversity gain can be earned.

[0047] (3rd operation gestalt) Drawing 3 shows the example of a

configuration of the radio equipment concerning the 3rd operation gestalt of this invention. With the 3rd operation gestalt, while arranging all antennas to the body side of a computer, the 1st wireless circuit containing the filter and LNA (low noise amplifier) of the first rank is arranged directly under each antenna.

[0048] As for a luggable computer 30, radio equipment has Antennas 331-33N, the 1st wireless circuits 391-39N, the 2nd wireless circuit 341, the synthetic processing section 35, the signal-processing section 36, the interface (I/F) section 37, and a control section 38 including a luggable computer 30 and wireless PC card 40. On the other hand, wireless PC card 40 has the 2nd wireless circuits 342-34N, the 2nd wireless circuits 341-34N of the 3rd operation gestalt -- the 1st and 2nd operation gestalt -- differing -- the first rank -- a filter and LNA are not included. LNA etc. is arranged near the antenna 33 by the side of a computer 30 as a circuit 39 according to individual (the 1st wireless circuit).

[0049] That is, with the 3rd operation gestalt, wireless PC card 40 has two or more wireless circuits (the 2nd wireless circuit) 342-34N which do not contain LNA etc., and serves as the configuration that the 1st wireless circuits 391-39N which contain two or more Antennas 331-33N and LNA(s) in a luggable computer 30 beforehand are carried by the optimal arrangement.

[0050] It explains that a signal flows. First, after RF processing is carried out in the 1st wireless circuits 392-39N, and the signal received with Antennas 332-33N flows into wireless PC card 40 with which it was equipped after passing the I/F section 37 and is processed in the corresponding 2nd wireless circuits 342-34N, it is again sent to the synthetic processing section 35 through the I/F section 37. Here, it is received by the antenna 331 and diversity composition is performed with the input signal inputted through the 2nd wireless circuit 341 after processing by the 1st wireless circuit 391. At this time, a control section 38 is controlled so that the 2nd wireless circuits 342-34N of wireless PC card 40 and the 392-39Ns of the 1st wireless circuits of a luggable computer 30 are correctly connected in the I/F section 37.

[0051] general -- a low noise amplifier (LNA) -- a receiving circuit -- it is the amplifier of the first rank and the signal in front of a LNA input is a signal with worst S/N in a receiving system. For this reason, in order to avoid addition of a noise if possible, as for wiring from an antenna to LNA, shortening as much as possible is desirable. Therefore, by the configuration of the 3rd operation gestalt, although the components mark in a luggable computer increase, an antenna and LNA (the 1st wireless circuit) can be arranged to near, and degradation of the S/N ratio of an input signal can be

prevented, and from the point of improvement in the quality of an input signal, it is an advantageous configuration. Moreover, the power consumption in the wireless circuit in a PC card can be reduced by arranging LNA39 which is an active component to the body side of a computer. Furthermore, it is effective to arrange LNA also in respect of the cure against heat on the body of a computer with which the cure against heat is fully performed.

[0052] Although it is the gestalt which includes the RF signal-processing component to LNA as the 1st wireless circuit with the 3rd operation gestalt, a subsequent filter, a subsequent frequency variable circuit, etc. may carry out N individual preparation beforehand into a luggable computer. In this case, although divided into the 2nd wireless circuit which carries out frequency conversion of the input signal processed in the 1st wireless circuit of N individual linking directly to an antenna, and the 1st wireless circuit further, the remainder will be built in a wireless PC card that what is necessary is just to prepare only 2nd at least one wireless circuit in the luggable computer.

[0053] (4th operation gestalt) The example of a configuration of the radio equipment applied to the 4th operation gestalt of this invention at drawing 4 is shown. With the 4th operation gestalt, it considers as the structure of performing synthetic processing of diversity, beamforming, etc. in DSP and the gate array in which it is contained by the PC card.

[0054] In the example shown in drawing 4, a luggable computer 50 has Antennas 531-53N, the wireless circuit 541, the signal-processing section 56, the interface (I/F) section 57, and a control section 58. On the other hand, wireless PC card 60 has the wireless circuits 542-54N and the synthetic processing section 55. Here, N expresses the number of the wireless circuits corresponding to the antenna and it which are contained in the whole radio equipment of this invention.

[0055] the wireless circuits 541-54N -- the 1st and 2nd operation gestalt -- the same -- the analog circuit of RF bands, such as a switch, a filter, amplifier (LNA is included), a mixer, and a synthesizer, and IF band, and the A/D converter which carries out a down convert and which is changed into a digital signal in a suitable frequency band -- depending on a communication mode, a digital circuit etc. is included further.

[0056] With the 4th operation gestalt, although the point that two or more antennas 531-53N are beforehand carried in the luggable computer 50, and the point that two or more wireless circuits 542-54N are carried in wireless PC card 60 are the same as the 2nd and 3rd operation gestalts, it differs in that the synthetic processing section 55 is contained in wireless PC card 60.

[0057] It explains that the signal in this radio equipment flows. First, after the signal received with Antennas 532-53N flows into wireless PC card 60 with

which it was equipped after passing the I/F section 57 and is processed in each wireless circuits 542-54N, it is sent to the synthetic processing section 55. Moreover, after the signal received with the antenna 531 is processed in the wireless circuit 541 by the side of a body, it is sent to the synthetic processing section 55 by the side of a PC card through the I/F section 57. Beamforming is performed in the synthetic processing section 55, and it is again sent to the signal-processing section 56 through the I/F section 57. At this time, a control section 58 is controlled so that the wireless circuits 542-54N of wireless PC card 60 and 532-53 Ns of antennas of a luggage computer 50 are correctly connected in the I/F section 57.

[0058] A control section 58 is controlled again not to send the input signal from the wireless circuit 541 by the side of a body to the signal-processing section 56 directly, but to be sent to the synthetic processing section 55 by the side of a PC card from the I/F section 57, when equipped with wireless PC card 60. On the other hand, when not equipped with wireless PC card 60, it controls to send to the direct signal-processing section 56.

[0059] Thus, without changing the body of a luggage computer by carrying the synthetic processing section on a wireless PC card, it can change into the diversity approach and beamforming algorithm suitable for a surrounding radio-wave-propagation situation easily, and the optimal communication link can be performed.

[0060] Thus, the configuration which prepares the synthetic processing section in a wireless PC card is applicable also to the radio equipment of the 1st operation gestalt - 3rd operation gestalt. In this case, each once regains two or more input signals delivery and after that at the signal-processing section by the side of the body of a computer in the synthetic processing section by the side of a wireless PC card, and decode processing is performed.

[0061] Also in any of the 1st operation gestalt - 4th operation gestalt, radio equipment of this invention can be considered as the configuration which displays the antenna branch used now, when change diversity control is performed. the image display according [ in / as shown in drawing 5 as the method of presentation / the screen top of a luggage computer ] to software -- or the LED display on a computer case etc. is raised. Moreover, when beamforming control is performed, a screen display of the directivity response pattern currently formed can also be carried out.

[0062] In the example of drawing 5, the antenna pattern seen from right above is displayed in the window on the screen of a computer. By such display, a computer user can know visually the communication direction which has secured the good propagation path, and he can move a luggage computer so that the user itself can perform a good communication link depending on the case. Moreover, there is an advantage which can be

employed and managed independently of the body of a computer by supplying a display function by software. It is independent, respectively and, of course, it is also possible to display the beam pattern of an antenna or the antenna branch currently used.

[0063] Furthermore, with the above-mentioned operation gestalt, although explained taking the case of signal reception, also in any of the 1st operation gestalt - 4th operation gestalt, the message or sending signal created by the body of a computer can also be transmitted from two or more antennas of radio equipment. By using two or more antennas, directional beam transmission is attained and directional gain improves. Thereby, even if radio wave propagation is an inferior environment, it can prevent a communication link stopping.

[0064] In addition, in the operation gestalt of all above, although the body of a walkie-talkie was explained as a luggage computer which has a wireless function and the removable peripheral device has been explained to a body as a wireless PC card, it cannot be overemphasized by building a small wireless circuit device etc. into the equipment which has the other same function, for example, a cellular phone and a Personal Digital Assistant, enabling free attachment and detachment that the same effectiveness is attained.

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[Translation done.]

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- 1.This document has been translated by computer. So the translation may not reflect the original precisely.
- 2.\*\*\* shows the word which can not be translated.
- 3.In the drawings, any words are not translated.

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**DESCRIPTION OF DRAWINGS**

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[Brief Description of the Drawings]

[Drawing 1] It is drawing showing the configuration of the radio equipment concerning the 1st operation gestalt of this invention.

[Drawing 2] It is drawing showing the configuration of the radio equipment concerning the 2nd operation gestalt of this invention.

[Drawing 3] It is drawing showing the configuration of the radio equipment concerning the 3rd operation gestalt of this invention.

[Drawing 4] It is drawing showing the configuration of the radio equipment concerning the 4th operation gestalt of this invention.

[Drawing 5] It is drawing showing the example of a display of the beam pattern of the antenna of the radio equipment of this invention.

[Drawing 6] It is the outline block diagram of the conventional personal computer with a wireless function.

[Description of Notations]

10, 30, 50 Luggable computer

20, 40, 60 Wireless PC card

13, 23,331-33N, 531-53N Antenna

14, 24,341-34N 541-54N Wireless circuit

15, 35, 55 Synthetic processing section

16, 36, 56 Signal-processing section

17, 37, 57 Interface (I/F) section

18, 38, 58 Control section

391-39N 1st wireless circuit

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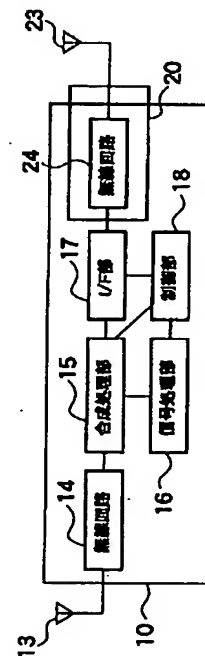
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(54) 【発明の名称】 無線装置

(57) 【要約】

【課題】 無線機本体を安価にし、かつ容易に通信機能の向上を図れる無線装置を実現化する。

【解決手段】 無線装置は、少なくとも1つのアンテナおよび少なくとも1つの無線回路を具備する無線機本体（たとえばポータブルPC）と、この無線機本体に着脱可能なPCカード等の無線回路付き周辺機器（たとえばPCカード）とから構成される。無線機本体は、周辺機器が装着された場合に、この周辺機器の無線回路を認識して、信号の伝達を可能にする接続手段を有する。無線機本体はさらに、接続手段によって認識された周辺機器の無線回路を経由した受信信号と、無線機本体の無線回路を経由した受信信号とを合成する合成手段と、合成手段で合成された受信信号を復号する復号処理手段を有する。周辺機器は所望の通信機能の通信回路を有し、これを無線機本体に装着することにより、ダイバーシチブランチとして認識させる。





## 【特許請求の範囲】

【請求項 1】 少なくとも 1つのアンテナと、少なくとも 1つの無線回路とを具備した無線機本体と、

少なくとも 1つのアンテナと、少なくとも 1つの無線回路とを有し、前記無線機本体に着脱可能な周辺機器とを備え、前記無線機本体は、

前記周辺機器が無線機本体に装着された場合に、前記周辺機器の無線回路を認識して、信号の伝達を可能にする接続手段と、

前記接続手段によって認識された周辺機器の無線回路を経由した受信信号と、前記無線機本体の無線回路を経由した受信信号とを合成する合成手段と、

前記合成手段で合成された受信信号を復号する復号処理手段とをさらに具備することを特徴とする無線装置。

【請求項 2】 2つ以上のアンテナと、少なくとも 1つの無線回路とを具備した無線機本体と、

少なくとも 1つの無線回路を具備し、前記無線機本体に着脱可能な周辺機器とを備え、前記無線機本体は、

前記周辺機器が無線機本体に装着された場合に、前記周辺機器の無線回路を認識して、信号の伝達を可能にする接続手段と、

前記接続手段によって認識された周辺機器の無線回路を経由した受信信号と、前記無線機本体の無線回路を経由した受信信号とを合成する合成手段と、

前記合成手段で合成された受信信号を復号する復号処理手段とをさらに具備することを特徴とする無線装置。

【請求項 3】 前記無線機本体の 2つ以上のアンテナの一部は、当該無線機本体の各無線回路に対応し、前記無線機本体のアンテナの残りは、前記周辺機器の各無線回路に対応することを特徴とする請求項 2に記載の無線装置。

【請求項 4】  $N$  個 ( $N \geq 2$ ) のアンテナと、前記  $N$  個のアンテナで受信された信号に対して高周波信号処理を施す  $N$  個の第 1 無線回路と、前記高周波信号処理された受信信号に対してさらに低周波変換処理を行う  $m$  個 ( $m \geq 1$ ) の第 2 無線回路とを有する無線機本体と、

( $N-m$ ) 個の第 2 無線回路を有し、前記無線機本体に着脱可能な周辺機器とを備え、前記無線機本体は、前記無線機本体に前記周辺機器が装着された場合に、前記周辺機器の第 2 無線回路を認識し、信号の伝達を可能にする接続手段と、

前記接続手段を経由して伝達された前記周辺機器の第 2 無線回路を経由した ( $N-m$ ) 個の受信信号と、前記無線機本体の第 2 無線回路を経由した  $m$  個の受信信号とを合成する合成手段と、

前記合成手段で合成された受信信号を復号する復号処理手段とをさらに具備することを特徴とする無線装置。

【請求項 5】 少なくとも 1つのアンテナと、1つの無線回路とを具備した無線機本体と、

少なくとも 1つのアンテナと、少なくとも 1つの無線回

路とを有し、前記無線機本体に着脱可能な周辺機器とを備え、前記無線機本体は、

前記周辺機器が無線機本体に装着された場合に、前記周辺機器の無線回路を認識して、信号の伝達を可能にする接続手段をさらに有し、

前記周辺機器は、前記接続手段によって認識された無線機本体の無線回路を経由した受信信号と、前記周辺機器の無線回路を経由した受信信号とを合成する合成手段をさらに有することを特徴とする無線装置。

【請求項 6】 2つ以上のアンテナと、1つの無線回路とを具備した無線機本体と、

少なくとも 1つの無線回路を具備し、前記無線機本体に着脱可能な周辺機器とを備え、前記無線機本体は、

前記周辺機器が無線機本体に装着された場合に、前記周辺機器の無線回路を認識して、信号の伝達を可能にする接続手段をさらに有し、

前記周辺機器は、前記前記接続手段によって認識された無線機本体の無線回路を経由した受信信号と、前記周辺機器の無線回路を経由した受信信号とを合成する合成手段をさらに有することを特徴とする無線装置。

【請求項 7】  $N$  個 ( $N \geq 2$ ) のアンテナと、前記  $N$  個のアンテナで受信された信号に対して高周波信号処理を施す  $N$  個の第 1 無線回路と、前記高周波信号処理された受信信号に対してさらに低周波変換処理を行う 1つの第 2 無線回路とを有する無線機本体と、

( $N-1$ ) 個の第 2 無線回路を有し、前記無線機本体に着脱可能な周辺機器とを備え、前記無線機本体は、前記無線機本体に前記周辺機器が装着された場合に、前記周辺機器の第 2 無線回路を認識し、信号の伝達を可能にする接続手段をさらに有し、

前記周辺機器は、前記接続手段を経由して伝達された前記無線機本体の第 2 無線回路を経由した 1つの受信信号と、前記周辺機器の第 2 無線回路を経由した ( $N-1$ ) 個の受信信号とを合成する合成手段をさらに有することを特徴とする無線装置。

【請求項 8】 前記無線機本体の合成手段は、前記無線機本体に与えられる駆動ソフトウェアによって、その制御内容を書き換えられることを特徴とする請求項 1~4 記載の無線装置。

【請求項 9】 前記周辺機器の合成手段の制御内容は、当該周辺機器が無線機本体に付加されたときに、前記無線機本体に与えられる駆動ソフトウェアによって書き換え可能であることを特徴とする請求項 5~7 に記載の無線装置。

【請求項 10】 前記無線機本体は、表示部をさらに有し、前記アンテナおよび無線回路によって形成される指向性ビームのビームパターンを表示することを特徴とする請求項 1~9 に記載の無線装置。

【請求項 11】 前記無線機本体は、表示部をさらに有

し、前記アンテナおよび無線回路のうち現在使用中のアンテナおよび／あるいは無線回路を表示することを特徴とする請求項1～9に記載の無線装置。

【請求項12】 前記無線機本体は、メッセージ送信機能をさらに有し、前記無線機本体内で作成され変調されたメッセージは、前記無線装置のアンテナを介して送信されることを特徴とする請求項1～11に記載の無線装置。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明は、無線機本体と、無線機本体に着脱可能な無線回路付きの周辺機器とから構成される無線装置に関する。無線機本体とは、無線機能および信号処理機能を有するすべての装置を意味し、たとえば、無線機能付き可搬型コンピュータ、PDAなどの携帯情報端末、携帯電話や自動車電話などの通信端末をも含む。

【0002】

【従来の技術】近年の情報化社会の発展によって、パーソナルコンピュータおよび携帯情報端末の利用者数が年々増大しており、その利用方法も多様化してきている。これらの情報機器の性能向上が加速するにつれて、音声・メッセージ・画像等のマルチメディア情報をやりとりする個人ユーザも増え、多種多様でかつ大容量の情報をインターネット等を利用して送受信することも当然のこととなってきた。しかし、モビリティや可搬性を考慮すると、有線の電話回線を利用するには限界があり、ノートパソコンに携帯通信端末を接続したり、無線データ通信専用のモデムカード等を挿入したりする必要がある。

【0003】逆に、携帯電話やPHSといった携帯通信端末自体でインターネットやEメール等を利用するユーザも増え、さらにiモードのような情報端末によって直接情報サービスを利用する頻度も高まっている。しかし、携帯端末上の操作は、筐体サイズが小さいことや、操作キーの少なさ等からくる入力速度の低下や、煩雑さは避けられない。

【0004】このような状況から、今後はこれらを混在あるいは統合した情報通信機器が登場することが容易に予想できる。例えば、ノートパソコンに無線LANやBluetoothなどのアンテナおよび無線機を搭載した機種などが市場に出回ると予想され、実際に商用化されているものもある。

【0005】図6は、現在考えられている無線機能を統合した情報処理機器である。このような無線機能を具備した可搬型パソコンがあれば、通信可能エリア内においては屋内外問わずに「いつでもどこでも」通信を行うことができることになる。しかし現実には、屋外の場合は、地形地物による伝搬ロスや、建物のかげに入り込んだときのシャドーイング等の影響を強く受ける。また、端末自体を動かすことがなくても、周囲の環境の時間的

変動のために反射・散乱の状態が変化し、フェージングが発生することもある。結果的にこれらの現象により無線回線品質が著しく劣化することになり、パソコンで大容量の情報を扱うことはできても送受信することができなくなる。

【0006】また、屋内で無線通信を行う場合においても、天井・壁等の反射や、什器や人による遮蔽が頻繁に生じるため、パソコンの置き方や設置場所によって、無線回線状況が悪くなったときに情報伝送速度が低下したり、通信が途絶えたりする等の不都合が生じる。

【0007】これを解決するために、図6に示するような無線機能付きパソコンあるいは携帯情報端末などに複数のアンテナおよび無線回路を組み込むことによって、ダイバーシチ動作を行い、著しい特性改善が見込まれる。端末の筐体の大きさの限度内で、無線機モジュールの数が増えれば増えるほどその効果は大きくなる。

【0008】

【発明が解決しようとする課題】しかしながら、このような複数の無線回路を具備したパソコンあるいは携帯情報端末は、データ処理等の基本機能に追加して余剰に搭載する通信機能のために、パソコンあるいは携帯情報端末の価格が高くなることが避けられない。このことは、特に高性能な無線通信機能を必要としないパソコン利用者にとっては、非常に不利である。

【0009】本発明は、このような問題を解決するためになされたものであり、価格の増大を抑え、かつ、利用者が必要とする通信品質あるいは通信速度を利用者毎の目的に応じて達成できる無線装置を提供することを目的とする。

【0010】

【課題を解決するための手段】上記目的を達成するために、本発明においては、パーソナルコンピュータや通信端末などの情報処理機器側に最小限の通信機能を組み込んで無線機本体とする。一方、利用者が個別に必要なとする無線通信機能を、無線機本体に容易に着脱可能な周辺機器、例えば無線PCカードに組み込むことによって、必要なときに、必要な通信機能を追加することのできる構成とする。

【0011】具体的には、本発明の第1の形態においては、無線装置は、少なくとも1つのアンテナと少なくとも1つの無線回路を具備した無線機本体と、少なくとも1つのアンテナおよび少なくとも1つの無線回路を有して、無線機本体に着脱可能な周辺機器とから構成される。無線機本体は、周辺機器を付加したときに、周辺機器の無線回路を認識して信号の伝達を可能にする接続手段をさらに有し、接続手段によって認識された周辺機器の無線回路を経由した受信信号と、無線機本体の無線回路を経由した受信信号とを合成手段で合成する。合成された受信信号を、無線機本体の復号処理手段で復号する。

【0012】このような構成により、あらかじめ数多くのアンテナおよび無線回路をすべて組み込んだ無線機本体に比べて、コストを低減することができる。また、無線機内の1系統の無線回路だけでは、所望の受信品質あるいは情報伝送速度を達成できないような劣悪な電波伝搬環境で使用する場合には、無線機能を有する周辺機器を装着することによって、ブランチ数を増やしてダイバシティ利得を向上させることができる。これにより、高い通信品質、高速伝送が実現される。また、付加する周辺機器は容易に着脱可能であるため、利用者は用途、要求するスペックに応じた周辺機器を使い分けることができる。さらに、機器製造者は多種多様な機能をもつ周辺機器を用意することができる。

【0013】本発明の第2の形態においては、アンテナをすべて無線機本体側に備えて、あらかじめ本体側でアンテナ位置の最適化を図り、周辺機器には無線回路のみを具備させる構成とする。

【0014】すなわち、無線装置は、2つ以上のアンテナと少なくとも1つの無線回路とを具備した無線機本体と、少なくとも1つの無線回路を具備して無線機本体に着脱可能な周辺機器とから構成される。無線機本体は、周辺機器が無線機本体に付加された場合に、周辺機器の無線回路を認識して、信号の伝達を可能にする接続手段を有する。無線機本体はさらに、接続手段によって認識された周辺機器の無線回路を経由した受信信号と、無線機本体の無線回路を経由した受信信号とを合成する合成手段と、合成手段で合成された受信信号を復号する復号処理手段とを有する。

【0015】この構成により、アンテナ位置の最適化を図ると同時に、周辺機器からアンテナを省略して小型化・低コスト化し、多様な機能、種類の周辺機器を安価に提供することが可能になる。最適位置に配置された複数のアンテナを用いて指向性ビーム送信が可能となり、指向性利得の向上により、劣悪な電波伝搬環境下においても通信が途絶えるのを防ぐことができる。

【0016】第3の形態では、アンテナをすべて無線機本体側に最適配置し、かつ、無線回路内の初段のフィルタや低雑音増幅器(LNA)などを無線回路から独立させてアンテナ近傍に配置する。一方、必要な無線回路を有する周辺機器を着脱可能に設けて、受信信号の質のさらなる向上を図る。

【0017】すなわち、無線装置は、無線機本体と、これに着脱可能な周辺機器から構成され、無線機本体は、 $N$ 個( $N \geq 2$ )のアンテナと、 $N$ 個のアンテナで受信された信号に対して高周波信号処理を施す $N$ 個の第1無線回路と、高周波信号処理された受信信号に対してさらに低周波変換処理を行う $m$ 個( $m \geq 1$ )の第2無線回路とを有する。一方、周辺機器は( $N-m$ )個の第2無線回路を有し、その各々が、無線機本体側のアンテナのひとつと対応する。無線機本体は、無線機本体に周辺機器が

装着された場合に、周辺機器の第2無線回路を認識し、信号の伝達を可能にする接続手段を有する。無線機本体はさらに、接続手段を経由して伝達された周辺機器の第2無線回路を経由した( $N-m$ )個の受信信号と、無線機本体の第2無線回路を経由した $m$ 個の受信信号とを合成する合成手段と、合成手段で合成された受信信号を復号する復号処理手段とを有する。

【0018】この構成は、アンテナと初段の増幅器(すなわち第1無線回路)が無線機本体内で空間的に離れて配置されることに起因する受信信号のSN比の劣化を防ぐことができる。また、無線機本体の複数のアンテナで受信した信号を、各アンテナの直下に位置する高周波無線回路でアナログ信号処理を施し、低周波信号に変換しておくことによって、無線機本体と周辺機器とのインタフェース部の構造を簡単化することができる。さらに、周辺機器内の無線回路における消費電力を低減することができる。

【0019】上記第1から第3の形態において、信号合成処理部を無線機本体側に設けたが、いずれの形態においても、合成処理部を周辺機器に設ける構成とすることができる。この場合、周辺機器を無線機本体に装着した状態で、無線機本体の複数のアンテナで受信した信号をインタフェース部を介してすべて周辺機器へ伝達し(そのうちの1つの信号は本体側無線回路での信号処理済みである)、周辺機器内において合成処理までを行うことができる。この構成により、合成処理部におけるアルゴリズムの変更を容易に行える利点がある。

【0020】また、本発明の無線装置において、合成手段は、無線機外部から与えられる駆動ソフトウェアによってその制御内容を書き換えることができる。外部から与えられるとは、インターネットを介してダウンロードされるソフトウェアや、CD-ROMやフロッピー(登録商標)ディスクなどの記録媒体を介して与えられるソフトウェアを含む。この構成により、付加した周辺機器の無線回路を含めた無線装置内の信号処理内容を容易に書き換えることができ、機能変更も容易になる利点がある。

【0021】好ましくは、無線機本体は表示部をさらに有し、無線装置のアンテナおよび無線回路によって形成される指向性ビームのビームパターンを表示する。あるいは、無線装置のアンテナおよび無線回路のうち、現在使用中のアンテナと無線回路の一方または双方を表示する構成としてもよい。利用者は、表示により、良好な伝搬路の確保できている通信方向を視覚的に知ることができる。場合によっては、利用者自身が良好な通信を行えるように、可搬型コンピュータを最適な場所に移動させることができる利点がある。

【0022】なお、本発明において、「無線機本体」とは、少なくとも一つのアンテナおよび無線回路を具備した可搬型コンピュータ、携帯情報端末、移動通信電話、

その他、無線通信機能を有するあらゆる装置を含む。特に、可搬型コンピュータを用いる場合、多様な情報を処理する能力や、優れたユーザインタフェース等を利用することができる。また、コンピュータ内のCPUを利用した無線信号処理および制御も可能となる。さらに、無線機本体として、周辺機器の増設が容易でかつ拡張性にすぐれる利点がある。また、あらかじめ複数の受信回路を搭載した可搬型コンピュータに比べて本体のコストを低減することができる。

【0023】また、無線機本体はメッセージ送信機能を有し、無線装置のアンテナを介して、変調したメッセージを送信することができる。本発明の無線装置では、本体に周辺機器を着脱可能に組み合わせることにより、複数のアンテナで指向性ビーム送信が可能となる。したがって、指向性利得が向上し、劣悪な電波伝搬環境下においても通信が途絶えるのを防ぐことができる。

【0024】

【発明の実施の形態】以下、図面を参照して本発明の実施形態を説明する。

【0025】(第1実施形態)図1に本発明の第1実施形態に係る無線装置の構成例を示す。無線装置は、無線機本体としての可搬型コンピュータ10と、これに着脱可能に装着される無線PCカード20を含む。可搬型コンピュータ10は、1つ以上のアンテナ13(図1では1つのみを図示)、アンテナ13に対応する数の無線回路14(図1では1つのみを図示)、合成処理部15、信号処理部16、インタフェース(I/F)部17、制御部18を有する。一方、無線PCカード20は、1つ以上のアンテナ23(図1では1つのみを図示)およびこれに対応する数の無線回路24(1つのみを図示)を有する。以下の説明においても、可搬型コンピュータ10および無線PCカード20の各々に内蔵されているアンテナおよび無線回路は、説明の便宜上、1系統ずつとしているが、ダイバーシチ効果を向上させるためにそれぞれ複数有する構成であってもよい。

【0026】無線回路14および24は、スイッチ、フィルタ、アンプ、ミキサ、シンセサイザ等のRF帯およびIF帯のアナログ回路や、ダウンコンバートして適当な周波数帯においてデジタル信号に変換するA/D変換器、さらには通信方式によってはデジタル回路等を含む。アンプは、雑音成分を低減する低雑音増幅器(LNA)を含む。

【0027】このうち、可搬型コンピュータ本体10に内蔵されている無線回路14は、コンピュータ単体での通信を可能とするため、D/A変換器、電力増幅器(PA)等の送信系の回路も含まれている。一方、無線PCカード20に内蔵されている無線回路24の方は、送信系があってもよいが、以下の説明では、受信系のみが含まれているものとして記述する。

【0028】無線PCカード20が、例えば、可搬型コ

ンピュータ10のPCカードスロットに差し込まれると、制御部18は、I/F部17に無線PCカード20を認識させ、I/F部17において無線回路24との信号のやりとりが可能な状態にする。無線PCカード20に内蔵されている無線回路24を認識させる方法として、制御部18自体に認識させる方法の他に、コンピュータ10にインストールされるデバイスドライバによって制御部18にアクセスする方法等も可能である。制御部18が無線PCカード20を認識し接続が可能になると、無線PCカード20側の無線回路24も通信可能な状態になる。

【0029】合成処理部15は、本体側のアンテナ13で受信された信号と、PCカード20のアンテナ24で受信された信号とを合成する。信号処理部16は、合成された受信信号を復号する。

【0030】次に、信号の流れについて説明する。まず、無線機本体およびPCカードのアンテナ13、23で受信された信号は、それぞれ対応する無線回路14、24において所定の信号処理が施される。可搬型コンピュータ10の無線回路14で受信された第1の受信信号は、信号処理後に合成処理部5に伝達される。また、無線PCカード2の無線回路24で処理された第2の受信信号は、I/F部7を通じて、合成処理部5に伝達される。合成処理部15では、第1の受信信号と第2の受信信号とに対して、切り替えダイバーシチあるいは合成ダイバーシチが行われ、その合成信号は信号処理部16においてデータ復調が行われる。

【0031】これによって、複数のアンテナを用いて空間ダイバーシチ受信が可能となり、シャドーイングやフェージング等で電波伝搬環境が悪いときでも、情報伝送速度の低下や通信の瞬断を防ぐことができる。本発明では、無線装置に備えられたアンテナおよび無線回路の系の数が増えれば増えるほど、その効果も大きくなる。

【0032】ダイバーシチ方法については、ドライバソフトウェアによって決定され、制御部18を通じて命令が行われる。つまり、コンピュータの置かれている周囲の状況や電波伝搬環境に応じて、利用者が各自で、PCカードによる機能拡張、あるいはダイバーシチ方法等を選択することができる仕様となっている。

【0033】また、本発明の通信装置では、複数のアンテナの配置を考慮して積極的にビーム指向性を向けたり、干渉波の到来方向の指向性利得を下げたりすることもできる。特に、室内無線LANの形態で、ビームフォーミング用のPCカードを利用する場合は、見通しの確保や指向性を絞ることによって大きな品質改善を図れる。ビームフォーミング方法については様々なアルゴリズムが存在する。例えば、固定パターンのマルチビームを予め形成しておき、受信信号レベルやSN比等の情報によりビームを切り替える方法や、受信信号に含まれる既知系列や受信信号のもつ性質を利用して、誤差を最小

パージ合成が行われる。このとき制御部38は、I/F部37で無線PCカード40の無線回路34<sub>1</sub>～34<sub>N</sub>と可搬型コンピュータ30のアンテナ33<sub>1</sub>～33<sub>N</sub>が正しく接続されるように制御する。

【0046】このような構成により、第2実施形態にかかる無線装置では、複数のアンテナをあらかじめ可搬型コンピュータ30の筐体上に、理想的な状態で配置することができ、アンテナ間の距離や指向性の向きの最適化が容易となる。特に、ダイバースチ受信する場合には、サイズの小さいPCカード上に複数のアンテナを搭載するよりは、コンピュータ筐体の大きさを活用して、アンテナ間距離をできるだけ離すことができる。これによって、受信信号の空間相関を小さくし、ダイバースチ利得をかせぐことができる。

【0047】(第3の実施形態)図3は、本発明の第3実施形態に係る無線装置の構成例を示す。第3実施形態では、コンピュータ本体側にすべてのアンテナを配置するとともに、各アンテナの直下に、初段のフィルタやLNA(低雑音増幅器)を含む第1の無線回路を配置する。

【0048】無線装置は、可搬型コンピュータ30と無線PCカード40とを含み、可搬型コンピュータ30は、アンテナ33<sub>1</sub>～33<sub>N</sub>、第1無線回路39<sub>1</sub>～39<sub>N</sub>、第2無線回路34<sub>1</sub>、合成処理部35、信号処理部36、インタフェース(I/F)部37、制御部38を有する。一方、無線PCカード40は、第2無線回路34<sub>1</sub>～34<sub>N</sub>を有する。第3実施形態の第2無線回路34<sub>1</sub>～34<sub>N</sub>は、第1および第2実施形態とは異なり、初段フィルタおよびLNAを含んでいない。LNA等は個別の回路(第1無線回路)39として、コンピュータ30側のアンテナ33の近傍に配置される。

【0049】つまり、第3実施形態では、無線PCカード40は、LNA等を含まない複数の無線回路(第2無線回路)34<sub>1</sub>～34<sub>N</sub>を有し、可搬型コンピュータ30にあらかじめ複数のアンテナ33<sub>1</sub>～33<sub>N</sub>とLNAを含む第1無線回路39<sub>1</sub>～39<sub>N</sub>が最適配置で搭載される構成となる。

【0050】信号の流れについて説明する。まず、アンテナ33<sub>1</sub>～33<sub>N</sub>で受信された信号は第1無線回路39<sub>1</sub>～39<sub>N</sub>で高周波処理され、I/F部37を通過後、装着された無線PCカード40へ流れ込み、対応する第2無線回路34<sub>1</sub>～34<sub>N</sub>で処理された後、再びI/F部37を介して合成処理部35へ送られる。ここで、アンテナ33<sub>1</sub>で受信され、第1無線回路39<sub>1</sub>による処理後に第2無線回路34<sub>1</sub>を通して入力される受信信号と、ダイバースチ合成が行われる。このとき制御部38は、I/F部37で無線PCカード40の第2無線回路34<sub>1</sub>～34<sub>N</sub>と、可搬型コンピュータ30の第1無線回路39<sub>1</sub>～39<sub>N</sub>が正しく接続されるように制御する。

【0051】一般に低雑音増幅器(LNA)は受信回路初段のアンプであり、LNA入力直前の信号は受信系の中で最もS/Nの悪い信号である。このため、雑音の付加をできるだけ避けるために、アンテナからLNAまでの配線はできるだけ短くするのが望ましい。従って、第3実施形態の構成により、可搬型コンピュータ内の部品点数は増えるものの、アンテナとLNA(第1無線回路)を近くに配置して受信信号のS/N比の劣化を防ぐことができ、受信信号の品質の向上という点からは有利な構成である。また、アクティブ素子であるLNA39をコンピュータ本体側に配置することによって、PCカード内の無線回路における消費電力を低減することができる。さらに、熱対策の点でも、LNAを熱対策が十分に行われているコンピュータ本体に配置することは有効である。

【0052】第3の実施形態では、第1無線回路としてLNAまでの高周波信号処理素子を含めた形態になっているが、その後のフィルタや周波数変換回路等も、可搬型コンピュータ内にあらかじめN個用意してもよい。この場合、アンテナに直結するN個の第1の無線回路と、第1の無線回路で処理された受信信号をさらに周波数変換する第2の無線回路に分けられるが、第2の無線回路は可搬型コンピュータ内には最低1個だけ用意しておけばよく、残りは無線PCカードに内蔵されることになる。

【0053】(第4の実施形態)図4に本発明の第4の実施形態に係る無線装置の構成例を示す。第4実施形態では、ダイバースチやビームフォーミングなどの合成処理を、PCカードに内蔵されるDSPやゲートアレイにおいて行う構造とする。

【0054】図4に示す例では、可搬型コンピュータ50は、アンテナ53<sub>1</sub>～53<sub>N</sub>、無線回路54<sub>1</sub>、信号処理部56、インタフェース(I/F)部57、制御部58を有する。一方、無線PCカード60は、無線回路54<sub>1</sub>～54<sub>N</sub>と、合成処理部55を有する。ここで、Nは本発明の無線装置全体に含まれるアンテナおよびそれに対応する無線回路の数を表す。

【0055】無線回路54<sub>1</sub>～54<sub>N</sub>は、第1および第2実施形態と同様に、スイッチ、フィルタ、アンプ(LNAを含む)、ミキサ、シンセサイザ等のRF帯およびIF帯のアナログ回路や、ダウンコンバートして適当な周波数帯においてディジタル信号に変換するA/D変換器、さらには通信方式によってはディジタル回路等を含む。

【0056】第4実施形態では、可搬型コンピュータ50にあらかじめ複数のアンテナ53<sub>1</sub>～53<sub>N</sub>が搭載されている点、および無線PCカード60に複数の無線回路54<sub>1</sub>～54<sub>N</sub>が搭載されている点は、第2および第3の実施形態と同じであるが、合成処理部55が無線PCカード60に含まれている点が異なる。



化するようなアンテナウェイトを求めることによって干渉波を除去するようなビームパターンを形成する方法、または各到来波の空間的な到来方向を推定し、それに応じてビームパターンのメインローブやヌルを向ける方法等がある。

【0034】このようなビームフォーミング受信は、ドライバソフトウェアにより制御内容を変更、または信号処理プログラムを書き換えることによって実現できる。しかし、到来波の到来方向等を精密に推定するようなアルゴリズムを用いる場合には、可搬型コンピュータ1および無線PCカード20に内蔵されている複数の無線回路間でキャリブレーションを行う必要がある。換言すると、パーソナルコンピュータ本体にPCカードの無線回路を合体させて双方の無線回路を正しく機能させるには、機能調整が必要であり、このための追加情報が必要になる。このような場合、例えばドライバソフトウェアによって、キャリブレーション部を駆動させるための処理命令を付加すればよい。

【0035】場合によっては、ダイバーシチ機能をもつPCカードに対して、その機能差分情報だけを盛り込んだハードウェアまたはソフトウェアで対処することによって、ビームフォーミングおよび/または無線回路間のキャリブレーションを実現することもできる。機能差分情報は、あらかじめハードディスクに格納しておいてもよいし、プログラムとしてロードしてもよい。ロード方法として、インターネットなどから無線機本体に直接ダウンロードすることもできる。

【0036】PCカードで通信機能を補強することによって、指向性利得の向上により、劣悪な電波伝搬環境下においても通信が途絶えるのを防ぐことができる。また、狭い指向性のビームを形成することにより、室内伝搬において頻繁に生じるマルチパスの影響を低減することができる。

【0037】第1実施形態の無線装置では、可搬型コンピュータ本体は最低限の通信機能だけを備え、高価になることはない。オプションの無線PCカードは着脱が容易であり、高い通信機能性を求める利用者に対しては、目的に応じた機能増設により、容易に拡張サービスを提供することができる。高性能を必要とする利用者は、目的に応じてPCカードを購入することになるが、あらかじめ固定されたマルチ通信機能コンピュータを購入するよりは費用、柔軟性の面で有利である。また、高い通信性能を必要としない利用者にとっては、基本的な通信機能の付いたコンピュータ本体を安価に購入することができるという利点がある。

【0038】また本発明の無線装置は、無線カードを着脱するための接続部の形態および接続方法には依存しない。すなわち、上記実施形態では、PCMCIAの無線PCカードを仮定しているが、I/F部17と無線PCカード20がケーブル等を介して離れて接続されている

もよい。この場合、可搬型コンピュータ10のアンテナ13と、PCカード20のアンテナ23がかなり離れて配置されるため、原理的には受信信号の空間的相関が小さくなるため、ダイバーシチ効果が高まるという効果がある。

【0039】また、可搬型コンピュータ利用者が大容量な情報や高品質な情報を送信する場合、つまり上り回線において高速・高品質伝送を行う場合、可搬型コンピュータあるいは無線PCカードに複数の無線回路およびアンテナが具備されていれば、送信ダイバーシチあるいはビームフォーミング送信を行うことができる。上述したように、ビームフォーミング送信を行う場合、各ブランチのアンテナ・無線回路間の精密なキャリブレーションが必要となるが、このための機能情報は、追加のソフトウェアをロードすることにより容易に実現できる。

【0040】このような構成により、空間ダイバーシチを利用した信頼度の高い伝送あるいは指向性利得の向上を実現でき、劣悪な電波伝搬環境下においても通信が途絶えたり、情報伝送速度が低下するのを防ぐことができる。

【0041】(第2の実施形態)図2に本発明の第2の実施形態に係る無線装置の構成例を示す。

【0042】第2実施形態では、複数のアンテナをすべて無線機本体側に配置することによって、あらかじめアンテナ位置の最適化を図る。すなわち、第2実施形態の無線装置は、可搬型コンピュータ30と、無線PCカード40とを含み、可搬型コンピュータ30は、2つ以上のアンテナ33<sub>1</sub>~33<sub>N</sub>、1つ以上の無線回路3

4<sub>1</sub>、合成処理部35、信号処理部36、インタフェース(I/F)部37、制御部38を有する。一方、無線PCカード40は、無線回路34<sub>1</sub>~34<sub>N</sub>を有する。ここで、Nは本発明の無線装置全体に含まれるアンテナの総数を表す。これは無線回路の総数にも一致する。

【0043】無線回路34<sub>1</sub>~34<sub>N</sub>は、第1実施形態と同様に、スイッチ、フィルタ、アンプ、ミキサ、シンセサイザ等のRF帯およびIF帯のアナログ回路や、ダウンコンバートして適当な周波数帯においてデジタル信号に変換するA/D変換器、さらには通信方式によってはデジタル回路等を含む。

【0044】第2実施形態では、無線PCカード40には、複数の無線回路34<sub>1</sub>~34<sub>N</sub>だけが含まれており、一方、可搬型コンピュータ30には、あらかじめ複数のアンテナ33<sub>1</sub>~33<sub>N</sub>が搭載されている。

【0045】第2実施形態の無線装置での信号の流れを説明する。まず、アンテナ33<sub>1</sub>~33<sub>N</sub>で受信された信号はI/F部37を介して、装着された無線PCカード40へ流れ込み、対応する無線回路34<sub>1</sub>~34<sub>N</sub>で処理される。その後、再びI/F部7を介して合成処理部35へ送られる。ここで、アンテナ33<sub>1</sub>から本体側の無線回路34<sub>1</sub>を通して入力される受信信号と、ダイ

【0057】この無線装置での信号の流れについて説明する。まず、アンテナ53<sub>1</sub>～53<sub>N</sub>で受信された信号は、I/F部57を通過後、装着された無線PCカード60へ流れ込み、各無線回路54<sub>1</sub>～54<sub>N</sub>で処理された後、合成処理部55へ送られる。また、アンテナ53<sub>1</sub>で受信された信号は、本体側の無線回路54<sub>1</sub>で処理されたのち、I/F部57を介してPCカード側の合成処理部55へ送られる。合成処理部55でビームフォーミングが行われ、再びI/F部57を介して信号処理部56へ送られる。このとき制御部58は、I/F部57で無線PCカード60の無線回路54<sub>1</sub>～54<sub>N</sub>と可搬型コンピュータ50のアンテナ53<sub>1</sub>～53<sub>N</sub>が正しく接続されるように制御する。

【0058】制御部58はまた、無線PCカード60が装着されているときには、本体側の無線回路54<sub>1</sub>からの受信信号を信号処理部56に直接送らず、I/F部57からPCカード側の合成処理部55に送られるように制御する。一方、無線PCカード60が装着されていないときには、直接信号処理部56に送るように制御する。

【0059】このように、無線PCカード上に合成処理部を搭載することにより、可搬型コンピュータ本体を改変することなく、周囲の電波伝搬状況に適したダイバーシチ方法やビームフォーミングアルゴリズムに容易に変更することができ、最適な通信を行うことができる。

【0060】このように、合成処理部を無線PCカードに設ける構成は、第1実施形態～第3実施形態の無線装置にも適用できる。この場合は、いずれも複数の受信信号をいったん無線PCカード側の合成処理部に送り、その後、コンピュータ本体側の信号処理部に取り戻して復号処理を行う。

【0061】本発明の無線装置は、第1実施形態～第4実施形態のいずれにおいても、切り替えダイバーシチ制御が行われたとき、現在使用されているアンテナブランチを表示する構成とすることができる。表示方法として、例えば、図5に示すように、可搬型コンピュータの画面上においてソフトウェアによる画像表示や、またはコンピュータ筐体上のLED表示等があげられる。また、ビームフォーミング制御が行われるときは、その形成している指向性パターン等を画面表示することもできる。

【0062】図5の例では、コンピュータのスクリーン上のウィンドウ内に、真上から見たアンテナパターンを表示している。このような表示により、コンピュータ利用者は、良好な伝搬路の確保できている通信方向を視覚的に知ることができ、場合によっては利用者自身が良好な通信を行えるように、可搬型コンピュータを移動させることができる。また、表示機能をソフトウェアで供給することにより、コンピュータ本体とは独立に運用、管理できる利点がある。アンテナのビームパターンととも

に、あるいはそれぞれ単独で、使用されているアンテナブランチを表示することも、もちろん可能である。

【0063】さらに、上記実施形態では、信号受信を例にとって説明してきたが、第1実施形態～第4実施形態のいずれにおいても、コンピュータ本体で作成されたメッセージあるいは送信信号を、無線装置の複数のアンテナから送信することもできる。複数のアンテナを用いることにより、指向性ビーム送信が可能になり、指向性利得が向上する。これにより、電波伝搬が劣悪な環境であっても、通信が途絶えるのを防ぐことができる。

【0064】なお、上記すべての実施形態においては、無線機本体を、無線機能を有する可搬型コンピュータとして説明し、本体に着脱可能な周辺機器を無線PCカードとして説明してきたが、それ以外の同様な機能を有する装置、たとえば、携帯電話や携帯情報端末に、小型無線回路デバイスなどを着脱自在に組み込むことによって同様の効果が達成されるのは、言うまでもない。

【0065】

【発明の効果】以上説明したように、本発明によれば、複数のアンテナを有する無線装置を、少なくとも一つのアンテナおよび無線回路を具備した可搬型コンピュータと、それに着脱可能な無線回路付きのPCカードとに分けて構成する。可搬型コンピュータ本体には、必要最小限の通信機能だけを備えて低コスト化を図り、一方、高速・高品質な通信を要求する利用者に対しては、その目的に応じて無線PCカードを付加し、ダイバーシチ効果によって、自在に性能向上を図ることができる。

【0066】また、ダイバーシチ方法や信号処理に関するパラメータ等は、ドライバソフトウェアで提供することにより、内容変更や機能拡張などの制御が容易になる。

【0067】ダイバーシチの代わりに、あるいはこれに加えてビームフォーミングアルゴリズムを導入することによって、指向性利得の向上や干渉除去効果のために、劣悪な電波伝搬環境下においても通信が途絶えるのを防ぐことができる。

【0068】さらに、このとき、キャリブレーション方法等、両者のアルゴリズムにおける差分情報もまたドライバソフトウェアを用いて認識させることによって、アルゴリズムの変更を容易にする効果がある。

【図面の簡単な説明】

【図1】本発明の第1実施形態に係る無線装置の構成を示す図である。

【図2】本発明の第2実施形態に係る無線装置の構成を示す図である。

【図3】本発明の第3実施形態に係る無線装置の構成を示す図である。

【図4】本発明の第4実施形態に係る無線装置の構成を示す図である。

【図5】本発明の無線装置のアンテナのビームパターン



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の表示例を示す図である。

【図6】従来の無線機能付きパーソナルコンピュータの概略ブロック図である。

【符号の説明】

10、30、50 可搬型コンピュータ

20、40、60 無線PCカード

13、23、33<sub>1</sub>～33<sub>N</sub>、53<sub>1</sub>～53<sub>N</sub> アンテナ

\*

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\* 14、24、34<sub>1</sub>～34<sub>N</sub> 54<sub>1</sub>～54<sub>N</sub> 無線回路

15、35、55 合成処理部

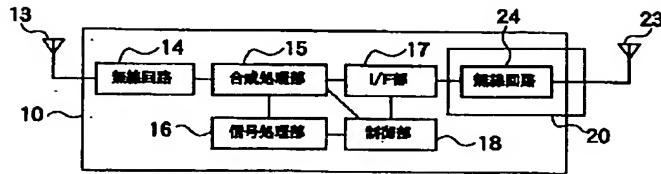
16、36、56 信号処理部

17、37、57 インタフェース(I/F)部

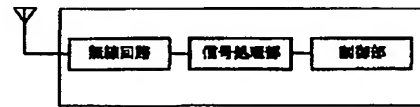
18、38、58 制御部

39<sub>1</sub>～39<sub>N</sub> 第1の無線回路

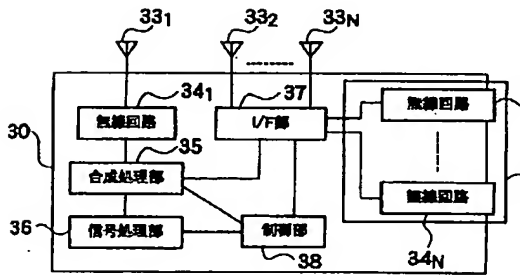
【図1】



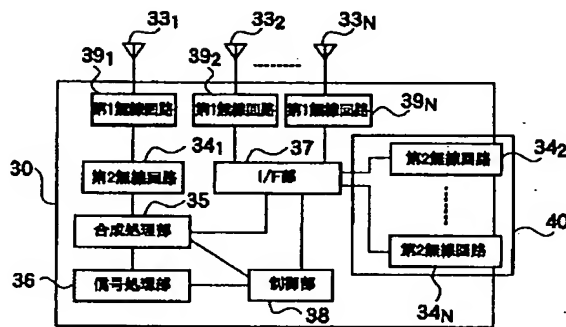
【図6】



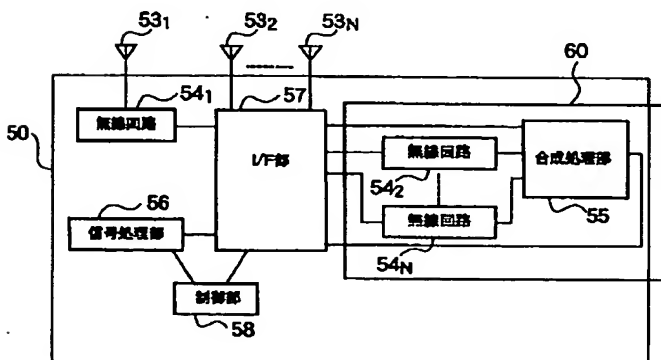
【図2】



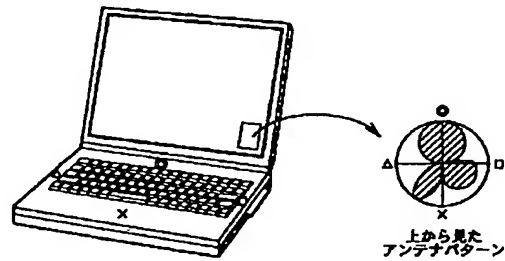
【図3】



【図4】



【図5】



フロントページの続き

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